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POWER GENERATION
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REFRIGERATION
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POWER MISCELLANY

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POWER

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July, 1935

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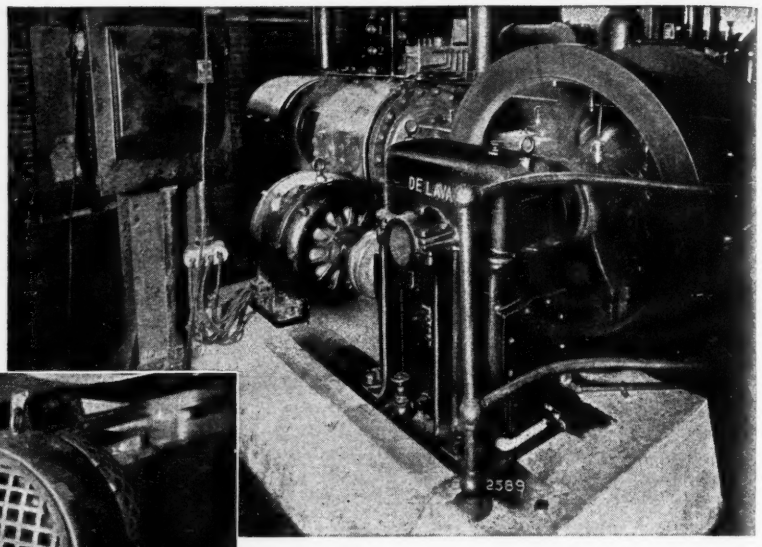
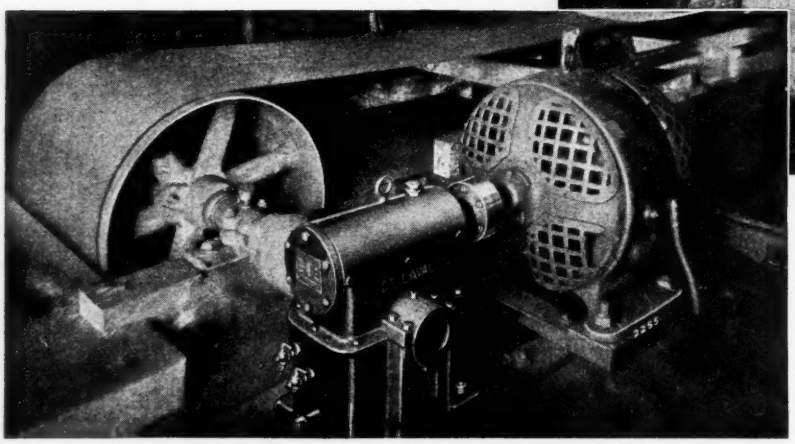
At Right—**The shock load encountered in driving a reciprocating vacuum pump** in a chemical plant (name upon request) has been carried by this 11-⅔ ratio De Laval worm gear **for nine years,** without renewal of or repair to any part. The motor delivers 40 hp. at 1160 r p m.





At Left—**1,510,000 tons of wet coal** have been passed over this belt conveyor in the plant of the Potter Coal & Coke Co. during some **nine years,** but the 25 to 1 ratio De Laval worm gear through which the belt is driven has given no trouble and has required no repairs.

9 Years UNDER DIFFICULT CONDITIONS *Means Something*

THE ability to carry heavy loads continuously for long periods under severe conditions of shock, grit, moisture and scant attention means that *DE LAVAL WORM GEARS* are:

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POWER

A McGraw-Hill Publication—Established 1884
PHILIP W. SWAIN, *Editor*

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SONG of SIXPENCE

MONEY earns more money only if it is working. We've repeated, you've argued, results have proved that money wisely invested in sensible modernization returns from 30 to 100% on the investment, sometimes more, not a paltry 2 or 3%. But holders of the purse strings have not been able to see it. Unreasoning, fanciful fear made them blind to the obvious; the urge to be amateur national economists made them forget their own businesses from which they were much more likely to get results. Also, NRA fixed product prices, enabled the inefficient and obsolete plant to compete with the progressive and modern.

But the pendulum has swung the other way. NRA is no more, and manufacturing costs—not labor rates—must be cut to assure profits. May 28, Congress added impetus to the pendulum swing by extending Federal Housing Administration's modernization credit plan to cover loans up to $50,000—*for modernization of equipment as well as buildings*—which means to power engineers that money can be had to buy badly needed recording instruments, revamp boiler plants, remodel heating systems, install modern generating and power-transmission equipment, add motors, or do whatever else is necessary to save a lot by spending a little. And the money comes without red tape, high interest, mortgage, endorsers, or trouble, and from private bankers or lending organizations, providing credit is reasonably good.

Maybe your company has its own money, doesn't need or want to borrow. The money has been there, but frozen tight by fear of a bogey man that fades at the touch. Government backing for modernization loans thus does one tremendous thing—it wipes out the bogey man and gives you a receptive audience when you present again—maybe for the Nth time—your power modernization ideas.

As far as FHA loans are concerned, there are no hooks. The Government simply promises to guarantee up to 20% of the total loans for "the purchase and installation . . . of such equipment and machinery, with or without structural changes in the building, as are peculiarly adapted to the business conducted therein or necessary to the operation thereof." That includes power plants of buildings, factories, institutions; compressor plants, elevators, refrigeration, air conditioning—almost anything so long as it isn't strictly portable like unattachable bench tools, desks or trucks. But a connection by wire, tube, hose or flue is considered attachment.

Requirements for such a guarantee? Simply that the loan be payable in monthly instalments, run not more than five years, carry an interest charge not exceeding $5 discount per $100 face amount of a 1-year note payable in monthly instalments. Your company deals with its own banker or lender, or FHA tells it where to find one. Your company makes its own bargain. The next two pages tell you in detail, how, when, where, what and give you examples, pointers, suggestions. What could be simpler? The sixpences you spend pay themselves back in saved power dollars that go out of the stack every day you delay.

MODERNIZE FOR PROFIT

It's an old slogan, but a fundamental one, and now the Government is backing it too, with guarantees on low-interest, instalment-repayment loans

IF YOU'VE read the preceding page, you know that America's power plants—in factories, buildings and institutions—face a new opportunity. You know that it is now possible to borrow substantial sums for plant modernization under terms better than you dared to expect. That further, if your company has money, this new Government backing provides you with a first-class reason for reopening the whole question of modernization of your power equipment and the tremendous potential profits from it, or continuing irrecoverable losses if it isn't done. To give you working tools, here is more specific information on the whole plan:

FHA

To refresh your memory, the Federal Housing Administration originally had two hundred million dollars with which to insure the makers of home modernization loans up to 20%. Loans were limited to $2,000 maximum, and FHA had underwritten $85,000,000 as of June 8 of advances for home and small property rehabilitation, thus has used only $20,000,000 of its appropriation. It therefore has $180,000,000 left. Remembering that FHA's function is to insure the lender against loss up to 20% of his total loans, the remaining $180,000,000 will insure $900,000,000 of additional loans, or 225,000 at the expected average of $4,000 apiece.

That's only the beginning, though, because FHA's experience in small-loan work over a year has been that many modernization projects are stimulated by the program for which the money is taken out of family or organization socks, in other words is never guaranteed by the Government but is at last put back into circulation due to the increased confidence engendered by the modernization program. Though FHA guaranteed only $85,000,000 worth of modernization, $450,000,000 worth was stimulated by it last year.

It all boils down to the fact that here is a source of money for that long-delayed modernization program if your company hasn't any to spend, or a good argument for shaking some loose if they have it. The facts are that they'll either spend it in anticipation of the need for higher efficiency, or increasing production and competitive conditions will force them to anyway eventually. So why not now?

The Amendment

The May 28 amendment included this (from Regulation No. 24 of Title I.) "An advance of credit in excess of $2,000 but not in excess of $50,000 for the purpose of (1) repair, alteration, or improvement of real property already improved by, or to be converted into . . . manufacturing or industrial plants, or (2) the purchase and installation, in connection with the foregoing types of property, of such equipment and machinery, with or without any structural changes in the buildings, as are peculiarly adapted to the business conducted therein or necessary to the operation thereof."

Where Loans Can Be Made

Over 5,000 banks and lending institutions now display the "house within a circle" that decorates these pages and is the emblem of the FHA. Any bank or lending institution can make such loans, providing only they meet the requirements that are listed below. It is also possible for commercial companies having reserves to set up credit units which can make loans to purchasers of that company's equipment and then get Federal insurance on the loans. American Radiator and Johns-Manville are two of the companies which have already done this very successfully.

If after contacting your banker or lending institution, your company still can't get a loan with FHA backing, contact the Administration itself in Washington. They'll be glad to advise you where you can get the loan on a legitimate project. Further, by the time this is published they will have ready booklets describing the whole idea and giving examples of what can be done by sensible modernization in every kind of industry.

Regulations

Regulations are extremely simple. Here are high spots:

Promissory notes must be in the form generally considered to be valid and enforceable in the state in which they are issued.

The sum total of bank charges (whether called "interest," "discount," "fee," or what have you) must not exceed an amount equivalent to $5 discount for $100 face value of a one-year note to be paid in equal monthly instalments. (This does not set a rate, only the *maximum* rate.) You may be fortunate enough to get money for 4 or 5% on a loan that still qualifies for FHA insurance. The maximum rate permitted works out to 9.71%, still only about half the general instalment purchase rates, and about equal to what you have to pay for a bond issue, stocks, or other financing.

Notes may not have a final maturity in excess of five years, and must be payable in equal monthly instalments. The first payment must start between 6 and 60 days after the date of the note.

If several pieces of property are involved, separate loans may be gotten on each for the maximum of $50,000 or to the extent of the borrower's credit, but no one piece of property can receive loans from several sources or receive several loans.

When a conditional sales contract, chattel mortgage, or other similar security device is used to secure the payment of the loans for eligible equipment and machinery the lending institution may not proceed against the equipment and also make claims under the contract of insurance, but must choose between them. (This provision discourages requiring of such security, because it is simpler for the lender to take free Government insurance.) After all, only a very small percentage of such loans are lost, so his insurance really amounts to almost complete protection.

Taxes, assessments and payments on principal or interest on mortgages on the property to be improved need only to be in such standing as to be acceptable to the financing institution. If the approved institution is

Some Figs

1. Singer Building, New York, N. Y., installed a 525-hp. diesel driving a 350-kw. d.c. generator to operate in parallel with steam-engine-electric plant. Unit improves heat balance, eliminates expensive outside standby service, halves power cost, and heats water with waste heat. Operating economies indicate that unit will pay out well within four years.

2. American Chicle Co., Long Island City, N. Y., installed 1,600 hp. of steam-turbine generators and now produces its power at one-half of purchased cost. Savings will pay entire cost of installation in 3.5 years.

3. Western Union Building, New York, N. Y., changed from coal to oil firing and made a saving in fuel and operating costs that will pay for change-over in two years.

4. An ice and refrigerating plant where all power was purchased, installed natural-gas engine driven generators for $38,500, now saves $13,000 per year on power costs, sufficient to pay all charges in less than three years.

5. An industrial power plant installs two 6,000-sq.ft. boilers, soot-blowers, ash-handling system, water-softening equipment and boiler meters. Saves $50,000 per year.

6. Dairyman's Cooperative Creamery Assn., Tulare, Calif., invests $21,000 in steam-engine generation to supply its power and saves $5,500 per year, paying for the equipment in four years.

7. Theo. Hamm Brewing Co., St. Paul, Minn., modernizes its power plant and is saving annually over $57,000 per year, sufficient to pay out in less than four years.

8. American Women's Assn. Club House, New York, N. Y., installed a power plant at cost of $110,000 and is now saving $47,000 per year under cost of purchasing steam and electricity.

9. Russia Cement Co., Golucester, Mass., modernized its steam plant by installing a 300-kw. steam-turbine generating unit. Results: purchased power costs cut 85% and fuel costs reduced 17%.

10. California paper mill modernizes by substituting synchronous motors for induction type on Jordan and beater drive, at cost of $14,000. Savings due to improved power factor and efficiency pay 27% on the investment.

11. Modernizing the power equipment in an Illinois machine-tool plant at a cost of $35,000 is paying over 31% return on the investment.

12. An investment of $8,000 in a Nevada copper mine to change from manual to full-automatic control on pumping equipment made a saving of over $10,000 per year, besides reducing maintenance costs on pumps and electric equipment.

13. At Chattanooga, Tenn., power drives in two packing and ice plants were modernized by installing synchronous motors on compres-

willing to extend the credit, the Government will insure the loan. Likewise, the financial condition of the borrower is left to the reasonable judgment of the financial institution as a credit matter. There are no fixed rules.

FHA will reimburse any insured institution for losses sustained up to a total aggregate amount equal to 20% of the total amount advanced on all qualified notes taken or purchased by it during the time its contract of insurance is in force, and held by it, or on which it remains liable. (In practice, with fair credit risks, this really gives more than 100% insurance to the lender.)

The advance of credit must be made for the purpose of (1) repair, alteration or improvement of real property already improved by, or to be converted into, apartment or multiple family houses, hotels, offices, business or other commercial buildings, hospitals, orphanages, colleges, schools or manufacturing or industrial establishments, or (2) the purchase and installation, in connection with the foregoing types of property, of such equipment or machinery, with or without any structural changes in the building, as are particularly adapted to the business conducted therein or necessary to the operation thereof.

All of this means simply that the government is opening banking facilities and thawing frozen credits. It is increasing dollar velocity—and the faster a dollar moves, the more work it does.

Also RFC and Federal Reserve

An industry can also get direct loans from the Government, but not through FHA. RFC and the Federal Reserve Banks make those. RFC loans are primarily intended to maintain and increase employment, although the original limitation that they be used to pay for labor and material incident to the operation of a business has been partially removed to cover plant rehabilitation and additional machinery.

Bankers may also make loans to furnish working capital on long terms and at the same time secure the promise of the Federal Reserve Bank to take over the loan at any time without recourse from 80% of it.

What About It?

Let's assume you've read all this with real interest, that you have definite modernization plans within the cost range and that you take them to your FHA bank and get a turndown—which is possible. Or let's assume that your bank isn't one of the 5,000 on the FHA list. In either case, don't give up. Write at once to the Federal Housing Administrator in Washington and ask him to suggest a bank or lending institution to which you can present your case.

Power is not a financial publication, but we feel it part of our job to talk turkey on a financial matter that so directly affects all users and makers of power equipment and on which their present information may be very incomplete. While *Power* cannot undertake loan negotiations, we stand ready to cooperate in bringing about a closer understanding between maker, user, lender and FHA to the advantage of all concerned.

We've estimated that about half of every power dollar spent in American industry is wasted—an aggregate national loss of at least $600,000,000 a year. Very conservatively (see *Power's* equipment survey reports in Mid-December, 1934, and January, 1935) more than half of industry's power equipment is obsolete. This clearly is the primary cause of the half-billion dollar loss.

To the extent of $50,000 per establishment the amendment clears away the last excuse for carrying this staggering burden of inefficiency. If the company uses its own money, that's all the better. Industry must realize that a power dollar saved is a dividend dollar—it goes directly into dividends, while profits on operation and savings elsewhere lose something in conversion.

Remember this: Half a loaf is better than none. When a large modernization project is blocked, there is still real opportunity for a test investment in a flowmeter or some other fast-paying power item. You help your employer and yourself. Indirectly, you help industry by stimulating buying, and this in turn increases manufacturing volume and lowers cost. So there you are—a circle, but not a vicious one.

Your banker or financial man will probably question your statement that power savings may run 30%, 50% or more. After all, his life has been spent in getting 10% as a high return. To make your task easier, we've picked out some typical and authentic examples from *Power* over the past few years. You may want to show "Some Figs from Thistles" to your executives or their financial advisors when presenting your plans.

To assist the whole idea, we'll be glad to provide reprints as long as they last.

Ten Points on FHA

1. FHA has $180,000,000 left of its original $200,000,000, the rest having insured $85,000,000 in home modernization loans averaging $400 each.

2. But it stimulated $450,000,000 worth of home modernization. The $180,000,000 left can insure $900,000,000 worth of loans, or 225,000 loans of the expected $4,000 average.

3. You can borrow $2,000 to $50,000 to modernize power equipment and buildings, to buy badly needed recording instruments, revamp boiler plants, install heating systems, install modern power-generating and transmission equipment, add motors, etc.

4. Interest rate is low; no red tape, no mortgage, no endorsers.

5. You don't beg or borrow government money; you deal with your own banker or any one of 5,000 qualified lenders.

6. He gets 20% insurance on total loans if they meet easy qualifications.

7. You pay the money back in monthly instalments; your savings should pay it for you.

8. After it pays for itself, the new equipment keeps right on paying in dividend dollars. And more important—the longer you delay the greater is your irretrievable loss from inefficiency.

9. The catch all along has been psychological. This breaks it. It builds faith. There's no altruism anywhere along the line. You use money now idle to buy new things. The banker makes a good loan. The government stimulates buying and improves business, adding a feather to its cap.

10. You don't need to borrow, you have the money? Fine! Then this government support for the "Modernize for Profit" idea gives you a new opening for asking that some of the reserves be shaken loose to go to work and earn 25 or 50% in power-dollar savings.

•

from Thistles

sors and high-speed induction motors on other drives. Yearly savings amounted to $9,700 in one plant and $4,500 in the other, or more than cost of the new equipment.

14. Modernizing its ventilating fans by installing synchronous motors and control, an Ohio mining company saves $4,500 annually on an investment of $3,258, a return of 138% per year.

15. Converting wound-rotor motors to synchronous types on its line-shaft drives, a California flour-milling company is saving $3,400 per year on a $9,400 investemnt.

16. A cold-storage and ice-plant company employed a consulting engineer to study its power problems. Part of power was generated by a hydro unit and part purchased. Changes made in the generator to permit using it for power-factor correction and power production resulted in a saving of over $2,000 per year, more than the total cost of the improvement.

17. Rosenbaum Grain Corp., Chicago, Ill., replaced old steam-power equipment in several elevators with synchronous motors and friction clutches. Now electric power for the motors costs less than coal for steam power.

18. Eaton Paper Co., Pittsfield, Mass., invests $525 in a 60-kva. capacitor to correct power factor and save $400 per year in power-demand charges.

19. United Steel & Wire Co., Battle Creek, Mich., installs capacitor costing $931 to correct power factor, and reduces purchased power costs $1,073 per year.

20. U. S. Reclamation District No. 1500 invested $70,000 to replace old pumping plant with a new one and in first two years of operation saved $62,600 in operating costs.

21. When old centrifugal pumps are replaced with new, the better efficiency and lower operating cost of the modern units frequently pays for the change in less than one year. A new pump can frequently be purchased for about what extensive repairs cost on an old one.

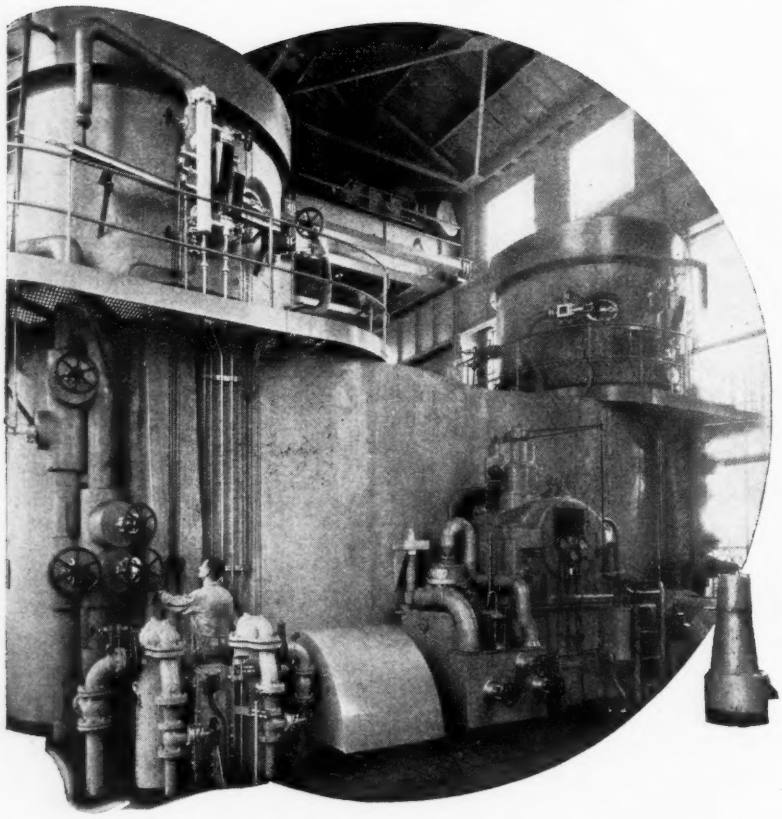
22. In a dairy plant a 15-hp. centrifugal pump is replaced with a 1.5-hp. unit that meets all requirements of the job and cuts operating cost sufficiently to pay for itself in three months.

23. A creamery installs three steam-flow meters at total cost of $975 and saves $1,500 the first year by intelligent operation.

24. Investment of $325 in a steam-flow meter increased the revenue from steam sold by a warehouse company $2,100 per year.

25. Reduction in peak loads as a result of electric-power maximum-demand studies, made with a demand meter costing $150, showed how to reduce power costs $156 per month in a Georgia industrial plant.

MERCURY VAPOR At KEARNY



Now it can be told. Second central station to install this binary-vapor cycle, Kearny has twice the capacity of the unit at South Meadow Station, Hartford, Conn.

KEARNY Generating Station of Public Service Electric & Gas Company (New Jersey) contains six steam turbines with a total capacity of 304,500 kw. Stoker- and oil-fired boilers supply steam to these turbines at 350 lb. pressure and 750 deg. F. temperature. During March, 1933, a General Electric 20,000-kw. mercury-vapor unit was superimposed on this station. Full load of 20,000 kw. has been carried on the new unit.

Room for the new unit was available opposite the last row of steam boilers, and it was only necessary to move a temporary wall out even with the turbine-room wall and to increase building height sufficiently to house the mercury turbine above the boiler. Existing building columns, however, were not sufficiently strong to carry the heavier load, so new columns were provided. Only slight changes in coal-handling facilities were necessary for the mercury boiler, which receives fuel from the weigh larry supplying the last row of steam boilers.

The mercury boiler consists of the main porcupine tube section, mercury walls extending down approximately 16 ft. below the bottom of the porcupine tubes and water-wall section protecting the lower part of the furnace walls. The bottom is also water-cooled. The unit is designed for firing with pulverized fuel supplied by two ball mills, each of 30,000 lb. per hr. capacity. Pulverized-fuel burners were adapted for oil burning, and this fuel has been used almost entirely.

Coal or oil is fired through four cross-tube type burners in both front and rear furnace walls. A forced-draft fan of 120,000-c.f.m. capacity at 14.9-in. pressure supplies secondary air through an air preheater of 37,850 sq.ft. of surface, which heats the air to 505 deg. It is of tubular type containing 2½-in. tubes 40 ft. long. Products of combustion are handled by an induced-draft fan of 204,000-c.f.m. capacity at 400-deg. temperature at 17.5-in. static pressure. The air preheater is designed to cool the gas from 645 to 335 deg. at full load.

As shown in Fig. 1, the boiler has seven mercury drums, 30 in. in diameter with walls 4 in. thick. The five center drums have eight rows of porcupine tubes, 55 tubes in each row; the two outer drums each have four rows of tubes.

Fig. 2 is a detail of the porcupine tubes which are approximately 5 ft. long. The outer calorized steel tube is welded to the boiler drum on the inside. It was not rolled into the drum because it would then be impossible to determine whether a tight joint had been made, and rolling alone is not satisfactory because of the high temperatures. A second tube is held in spaced relation within the outer tube by six steel ribs in its surface. The third tube is welded to the inside of the second tube at the bottom and top, and through this liquid mercury from the drum flows to the bottom of the porcupine tube. It will be noted that this inner tube is bent, and so provides for difference in expansion due to the lower temperature of the mercury in the center

tube. Mercury vapor generated in the annular space between the outer tube and the second tube rises through the six vertical channels formed by flutes up to the space between the separator plate and the drum. As in the Hartford installation, cast-iron blocks are installed in the drum to decrease the amount of mercury required, which for this installation amounts to 300,000 lb.

Mercury vapor is taken from each drum through two pipes welded to the drums at about one-third the distance from each end. They deliver to two horizontal headers which are cross-connected, and from both ends of these mercury vapor is supplied to the turbine above.

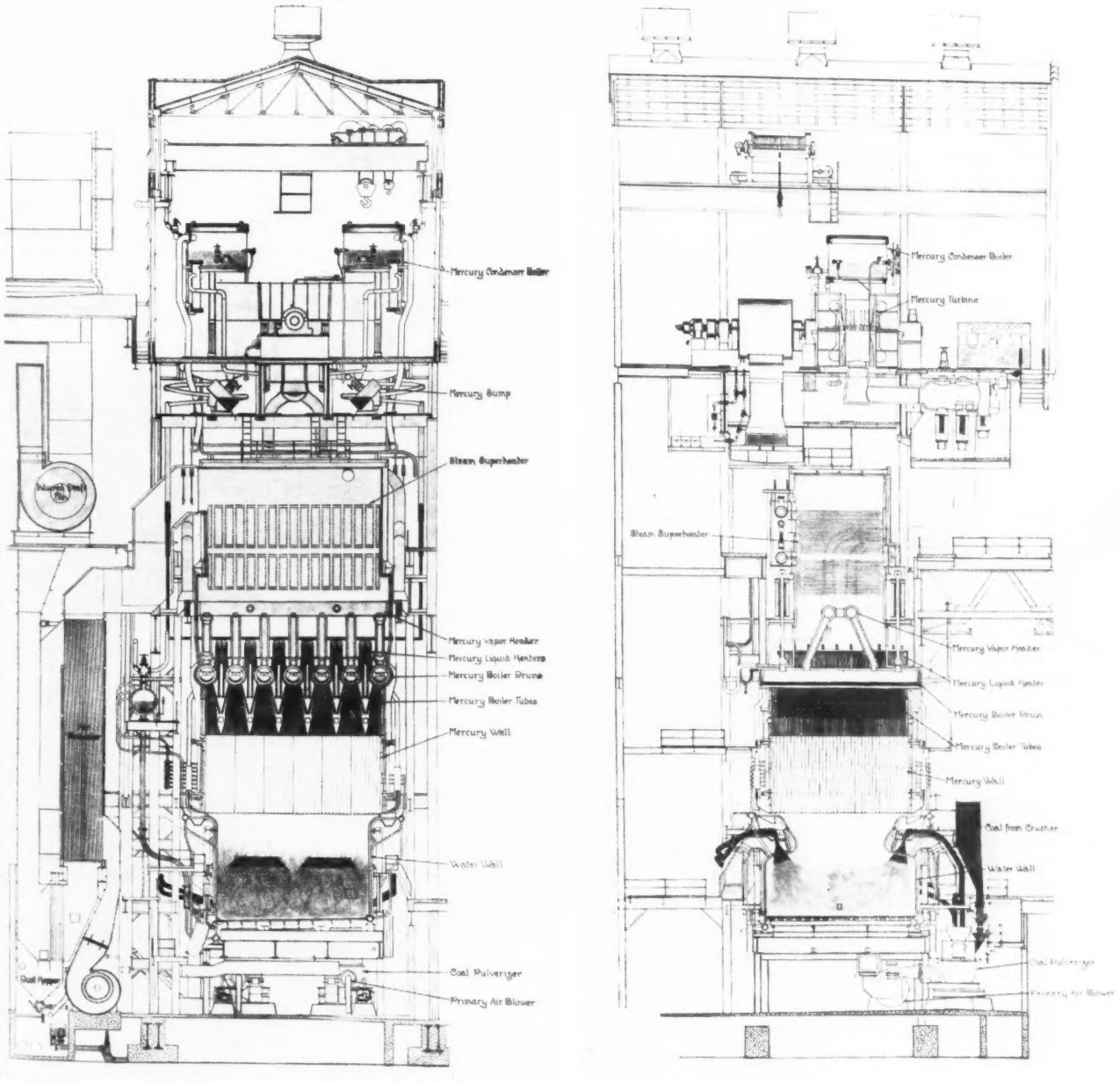
Two boiler safety valves are next to and ahead of the turbine throttle valve and, like steam practice, there is no valve between the boiler and safety valves. If for any reason the boiler pressure goes too high, these valves open and by-pass mercury around the turbine to the condenser-boilers where it is condensed and returned to the mercury boiler. Steam made in the condenser-boilers can then be blown to atmosphere if necessary.

Between the drums are liquid-mercury heaters which consist of economizer and vaporizing-economizer sections. Liquid enters through $1\frac{3}{4}$-in. I.D. headers supported on the mercury drums. It flows upward through calorized tubes that have been pressed to elliptical cross-section, and then down into the vaporizing-economizer section.

The vapor-economizer section consists of upper 4-in. and lower 2-in. headers, which are connected by $1\frac{1}{2}$-in. I.D. down-comers and by risers of elliptical cross-section. The riser tubes in this section of the economizer are bowed to provide for differences in expansion between riser and down-comer tubes.

Mercury walls consist of $\frac{7}{8}$-in. I.D. tubes. These tubes are grouped in threes and housed in steel boxes, a section of which is shown in Fig. 3. The boxes are filled around the tubes with copper to improve heat transfer. Mercury is supplied to the bottom of the walls, which are 21 ft. below the boiler drums, through large single tubes which spread out fanlike to the $\frac{7}{8}$-in. tubes forming the wall. For the front and rear walls,

Fig. 1—Back and side vertical sections of mercury-vapor unit



one such tube connects into the ends of each drum. For the side walls, six downcomer tubes are spaced along the length of the outside drums and welded in place, taking the place of the porcupine tubes omitted. At the upper end of the walls each group of three tubes is collected into a single tube welded into the boiler drum.

The major part of the water wall is covered with refractory applied over horizontal fins welded to the fire side of the tubes. It is fed from a single 48-in. dia. drum, located along the side wall of the furnace, slightly below the mercury boiler drums. Water walls were designed to generate about 90,000 lb. of steam an hour at full load.

Steam from water walls and condenser boilers is delivered through a superheater directly over the mercury boiler and is designed for 750 deg.

Mercury vapor from the boiler is delivered to the turbine at 125 lb. pressure and 958 deg. through two valves. These are oil-operated valves and arranged so that sylphon bellows take the place of packing, providing for movement of valve stem and a tight seal against loss of mercury. The two valves are in series, the one next to the turbine being the emergency valve and the other the hand-operated throttle valve. In operation, the throttle valve is opened by hand by admitting oil to the operating piston, the emergency valve opening automatically as soon as oil pressure is provided. Both valves are closed by operation of the overspeed trip mechanism, and the emergency valve is operated by the turbine governor, which however, is set above synchronous speed so that this valve normally is wide open. The generator operates in parallel with other station units, which control the frequency. Load on the turbine is usually governed entirely by the boiler pressure and amount of fuel fired, though it can be controlled by changing the setting of the emergency valve.

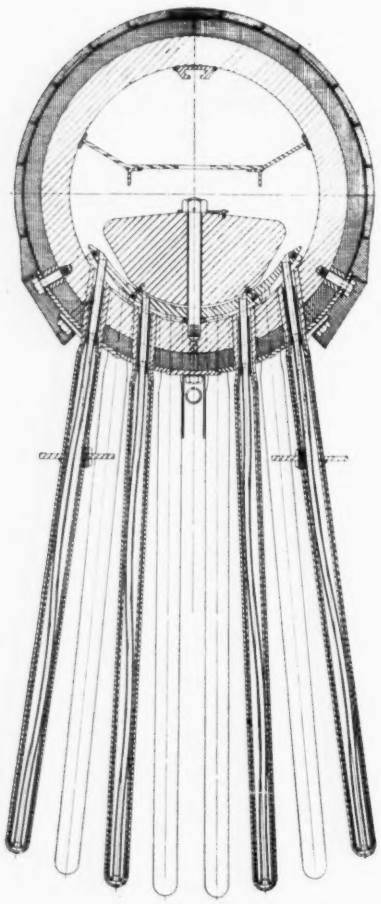


Fig. 2 — Section through mercury drum, showing detail of porcupine tubes

Mercury vapor is admitted at the center of the 5-stage double-flow turbine and flows axially in both directions. This arrangement eliminates the necessity of a high-pressure shaft seal or over-hung rotor as at Hartford. Water seals, of which there are two, have been provided to prevent leakage of air into the mercury system. Additional seals are provided to prevent

Fig. 3—Section of copper-filled mercury boiler wall

water from entering the mercury system. Any water that may leak past the first of these seals is vaporized because of the high temperature of the mercury. The chamber between the two seals is vented directly to the condenser steam-jet air-removal system. Pressure at this point is, therefore, maintained slightly less than the turbine exhaust pressure, thus preventing leakage of steam into the mercury system.

The turbine is designed to exhaust at 1.3 lb. abs. and 475 deg. into two condenser-boilers, one at each side of the turbine. Condensed mercury flows by gravity into two sumps immediately below the condensers and overflows to the mercury economizer. These sumps consist of cylindrical containers 63½ in. in diameter and mounted at an angle of about 45 deg. Inside the sumps are screens through which the mercury flows and to which any dirt that may be contained in the mercury adheres.

Condenser-steam boilers are fed with 340-deg. water from the station boiler feed-water system and are designed to generate 240,000 lb. of steam an hour at full load. Mercury vapor enters each of the 10 ft. dia. cylindrical condenser shells at two points. Water tubes, closed at the bottom, extend down into the shell and are arranged in lanes so that mercury vapor penetrates toward the center. Non-condensable gases consisting of air and steam are removed by steam-jet vacuum pumps. The steam dome section is welded to the top of the condenser shell and water fed to it flows down through inner tubes that extend into the main condenser tubes a distance of about 6 ft. These tubes are for the purpose of establishing circulation, steam rising along the inner surface of the main tubes which are 2 in. dia. and have 16 ft. of exposed surface.

An instrument operating with photoelectric tubes has been developed which will detect extremely small amounts of mercury in the flue gases, and by sounding an alarm immediately notifies the operator in case a mercury leak develops. It is so sensitive that 2.5 c.c. of mercury thrown into the furnace will set off the alarm.

Operation of a mercury unit is quite easy. As soon as about 25% of full-load pressure has built up, the throttle valve on the mercury turbine is opened slightly and the unit brought up to speed and phased in on the line, after which the throttle valve is opened wide. The turbine is then loaded by increasing the fire. Water in the condenser boiler is held at a normal level by a feed-water level regulator as in a steam boiler.

In shutting down, the fires are extinguished and the mercury turbine allowed to run so as to use the vapor that still comes from the mercury boiler.

VAN STONING WROUGHT IRON

It can be done easily without "sunflowering." The answer is proper temperature

SOME years ago, genuine wrought iron was not Van Stoned because fabricators could not prevent splitting of the flange. More recently they found how it could be done, but the special treatment made the process expensive. Now Van Stoning of wrought-iron pipe has become an established procedure, and is no more difficult than Van Stoning steel pipe.

Due to the fibrous structure of wrought iron, caused by the numerous minute strands or fibres of iron silicate uniformly distributed through the pure iron base metal, proper temperature is required to work the metal satisfactorily. Temperature is simply maintained above that which would cause a sharp decrease in ductility. The once common experience of splitting flanges, or "sunflowering," is now easily avoided.

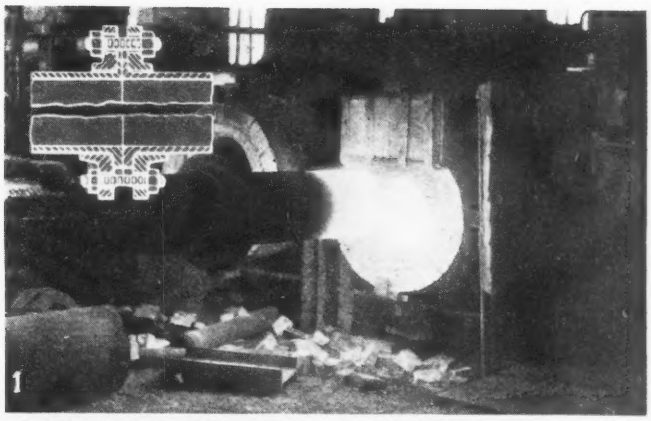
The same machinery is used for Van Stoning either wrought iron or steel. There are several satisfactory types of flaring dies, but any flaring tool which turns back the metal too suddenly or abruptly should be avoided. Hydraulic-feed machines of the type shown in Fig. 2 are in general more desirable than air-actuated types, because they are less "jumpy." The pipe is held stationary and the tools revolved on the head, forward feed also being in the head.

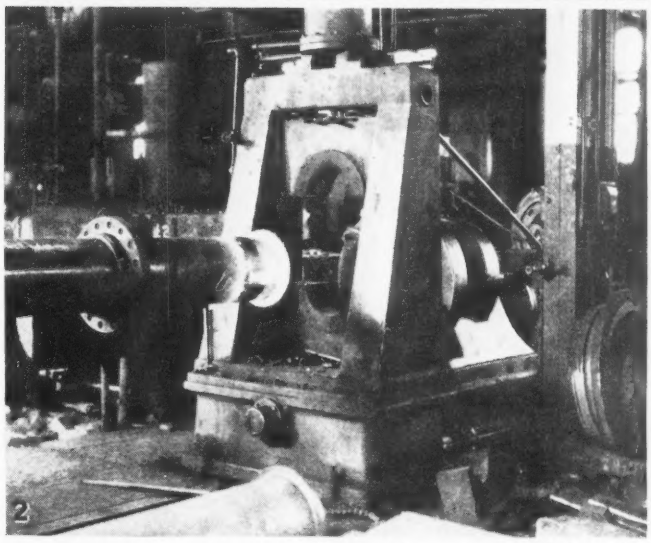
The procedure for Van Stoning wrought-iron pipe is: Heat the pipe on the end uniformly to a temperature above 2,100 to 2,200 deg. F. The surface of the metal at this temperature will be entirely fluxed, and a greasy or shiny appearance and dripping of the molten flux will become apparent. Be sure the heat extends far enough back on the pipe, as shown in Fig. 1. Then remove the pipe quickly from the furnace to the flanging machine and start flaring in the shortest possible time, in order that expanding of the material will take place while the wrought iron is at a temperature at which the iron silicate is either still liquid or at least plastic.

Fig. 2 shows the end of the pipe after Van Stoning has been performed. Flanging should not be carried too far on the initial heat, for the ductility of wrought iron in the transverse direction in which the material is worked is very low. The pipe should not be worked below 1,800 to 1,900 deg. F., because at this point the material is rapidly approaching the critical-temperature range. Discontinue flanging before tearing occurs. Heat the pipe again to the temperature just described as quickly as you can, and then continue or complete flanging.

With some larger sizes of pipe you may be able to complete flanging with one heat, but do not attempt this unless best possible equipment is available. With smaller sizes of pipe it is safer to use the reheating method, and in any case this method is recommended to those who have had but little experience with Van Stoning wrought iron.

The percentage of stretch of the metal is inversely proportional to the diameter of the pipe, and therefore it is more difficult to flange small-size pipe than large-size. In addition, the small-size pipe cools down more rapidly. Thickness of the pipe wall has its influence—the thicker the wall of the pipe the easier to Van Stone, for the reason that the metal seems to flow more satisfactorily and the stretch is better distributed throughout the metal. Naturally, then, extra-heavy pipe is preferable to standard-weight for Van Stoning. Van Stoning is usually done mostly on larger sizes of pipe, but can be performed on practically any size of wrought iron pipe, either standard or extra-heavy weight.





Photographs courtesy A. M. Byers Co.

Fig. 1 (Top)—Proper heating to Van Stone wrought iron. Inset is a cross-section of a typical Van Stone joint. Fig. 2—A flanged end, showing flanging press

VACUUM CLEANING THE POWER

Brooms are as outmoded in a power plant as in the home. In their place, suction cleaning removes the dirt conveniently and dustlessly

FIND a dirty power plant, and it is usually one that is poorly operated. One does not have to lean heavily upon his imagination to prove cleanliness the most important factor in plant operation. When operators have sufficient interest to keep a plant clean, high standards of operation just naturally follow. This being true, then proper cleaning equipment, intelligently used, pays large dividends on the investment, even if they may be difficult to express in dollars and cents.

When loose dust and dirt are to be removed, vacuum cleaning has many advantages. Other methods cause dust and dirt to move from one location to another, consequently the final cleaning must be done by wiping up with rags or waste. When vacuum cleaning is used, not only is the readily visible dirt removed, but also a large part of the dust which would otherwise get into suspension. Removing the latter eliminates an explosion hazard.

Boiler-Plant Cleaning

Around the power plant, vacuum cleaning can be applied to practically every class of cleaning, and some of the jobs cannot be done successfully by any other means. In the boiler room, where coal firing is used, the dust problem is a serious and a dangerous one, particularly with pulverized coal. Experience proves that this danger can be removed by proper cleaning. When stoker firing is used and around pulverized-coal feeders, coal sifts onto the floor. Coal dust in greater or lesser quantities finds its way into the atmosphere only to settle on trusses, pipe lines, boiler tops, equipment, and on any other surface where it can lodge. A properly installed vacuum-cleaning system will remove coal siftings dustlessly and will conveniently and safely clean dust from parts where it may lodge. Attempts to sweep coal dust from boiler tops and other parts of the plant has caused explosions because of dust clouds put into suspension in the atmosphere.

Tops of pipelines, building trusses and other parts and the boiler tops are a mean job to clean even under the best of conditions. Temperatures are usually high, surfaces are difficult to get at by most means of cleaning and when a dust cloud is added to these difficulties, one can hardly blame an operator for putting off the evil day of cleaning as long as possible. With a vacuum system this cleaning is done dustlessly, and tools can be provided that permit the job to be done conveniently and safely.

Around power-generating machinery, switchboards and other electrical equipment, vacuum cleaning has distinct advantages. First of all, it does the cleaning dustlessly. Because of the complications of wiring and other equipment on the back of a switchboard it is a difficult place to clean. In fact, about the only other way it can be cleaned, outside of a vacuum system, is by compressed air. By this means the dust is blown into suspension in the hope that it may be removed when it settles somewhere else.

Unless great care is used, there is always danger that compressed air may carry moisture in quantities sufficient to injure insulation. When compressed air is used for cleaning electrical machines, dirt is very likely to be blown into small crevices instead of out of the machine. As a case in point, compressed-air cleaning has packed the air gaps of induction motors so tightly with dirt as to overload the motor. To clear the trouble required dismantling of the motor and scraping the dirt off the stator and rotor cores. A heavy blast of compressed air may be injurious to insulation when directed onto it from a nozzle at close range. When carbon or graphite dust is present, compressed-air cleaning may drive the dust into cracks in insulation and permanently injure it.

Unfortunately, vacuum cleaning cannot do a 100% cleaning job around electrical machinery. Frequently the dirt is of such a character that it can be removed only by scraping or washing with a grease solvent. The dirt gets into ventilating ducts and other places where it is very difficult to reach, even when the machine is dismantled. That which can be removed readily, however, can be taken out by vacuum system. The part that cannot be taken out by this means is left very much in its natural state and is not driven harder into small spaces. Also the dirt that is removed is taken out without creating a dust to settle in some other location.

Vacuum-Cleaning System

Suction cleaning properly applied is not an expense, and considerable savings result from longer life of machinery, paint and improved working conditions. Good suction cleaning is the dustless method of removing and storing dust. Whether of the stationary or portable type, a vacuum-cleaning system can be divided into four divisions: the pick-up nozzle or cleaning tool, the conveying line of flexible hose or flexible hose and rigid pipe lines, the dust-separating equipment consisting of storage tanks with filters, and the power-driven vacuum producer or exhauster.

A vacuum-cleaning system, or vacuum cleaner for a power plant, cannot be purchased like a piece of equipment listed in a general machinery catalog. Nor can proper results be obtained by installing a machine because it happens to be rated at so much horsepower. Power required to operate a cleaning system should be the last thing considered. The efficiency of suction cleaning involves proper air velocity into the cleaning nozzle or tool, correctly designed cleaning nozzles or tools; right diameter and length of hose line to service

PLANT

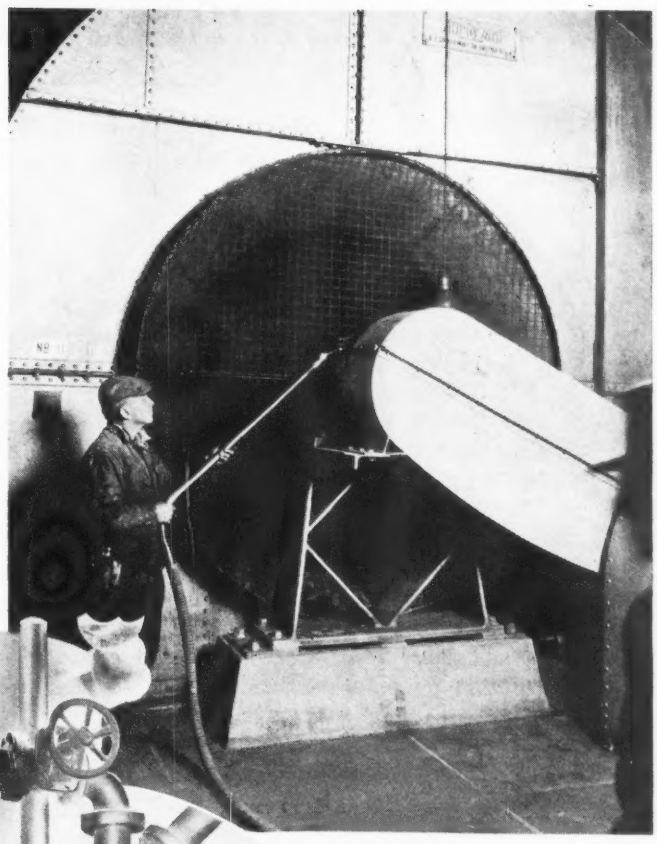
By Fred W. Lieberg

Engineer, B. F. Sturtevant Co.

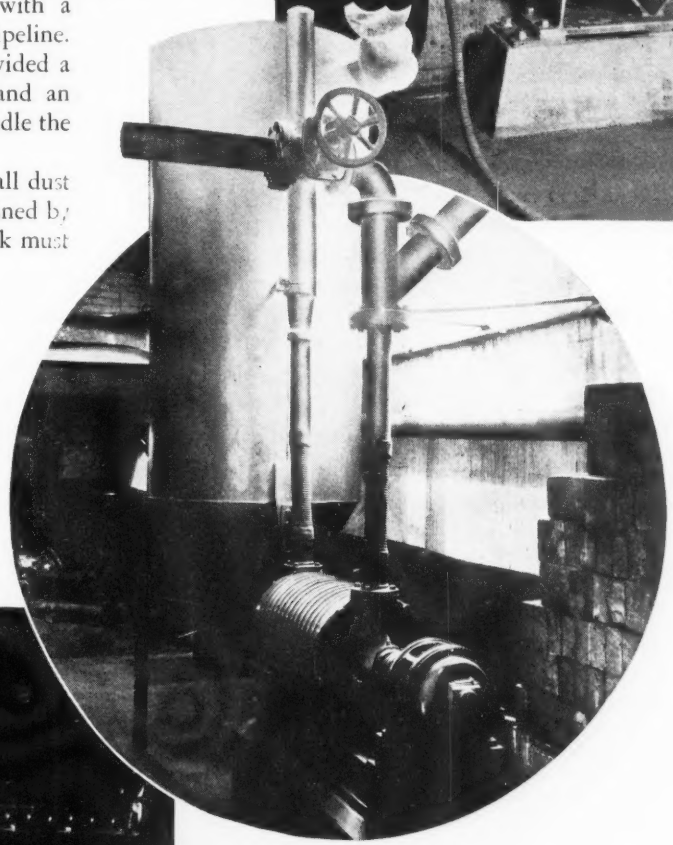
the tool; and a properly laid-out piping installation.

To estimate the requirements of a vacuum-cleaning system it is necessary to consider the kind of dust and accumulations to be handled. On the size and weight of material to be disposed of depends the type and size of cleaning tool and diameter of the tool throat. When coal siftings from automatic stokers are to be removed, a certain nozzle or tool is available to do the job most efficiently. If it is dust from the boiler tops, another kind of tool is provided best adapted to insure rapid work. Speed of cleaning is governed by the volume of air and size of cleaning tool used. A tool designed for rapid work must be coordinated with a properly proportioned hose and pipeline. At the end of the line must be provided a separating tank with proper area and an exhauster or vacuum producer to handle the necessary volume of air.

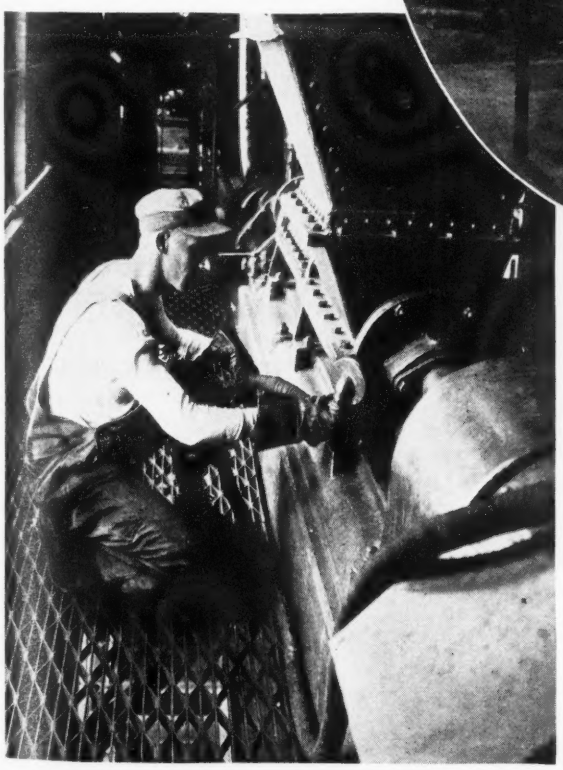
Dust separation is important and all dust and materal collected should be retained by the dust-separation tank. Such a tank must have cloth strainers or filters. A modern separating unit comprises a combination tank employing centrifugal action in a lower compartment and final separation by filter bags or tubes in an upper compartment. At least 90% of the material entering the tank is immediately precipitated to the lower compartment. The remaining 10%, in the nature of fly-dust, is collected by the filter and eventually drops to the same place.



Above — Hard-to-get-at places can be reached by long-handled cleaning tools



Left — Vacuum-cleaning plant comprising a motor-driven centrifugal exhauster and a combination precipitation filter-type dust-separating tank



Lower left—Corners and crevices where dust and dirt find resting places can be quickly and completely cleaned with this hand tool

With portable-type cleaners, dust separation is of primary importance. Portable types operate with their outlets within the building. If adequate filtration is not designed into the tank, to care for the type of cleaning tools and kind of dust being collected, unsatisfactory operation may result.

VENTILATING NEW YORK'S

A million and a quarter cubic feet a minute—that's combined capacity of the ventilating fans for the new 15,000,000-cu.ft. annex to New York General Post Office

TO VENTILATE the annex to the New York General Post Office, now nearing completion, fans having a total capacity of 1,260,950 c.f.m. have been installed. This federal project covers practically all of a plot 455 ft. long by 385 ft. wide and contains about 15,305,000 cu.ft. The building has five stories above the street and one story below, and is built entirely over the tracks of the Pennsylvania Railroad. High-tension wires for train operation made it impossible to carry any piping below the basement floor level. This introduced many difficulties in the matter of heating and even more serious ones with respect to drainage and soil piping. Other factors that complicated the heating and ventilating of this building were a driveway through the building and heating of the basement floor, which is exposed to outside temperatures on the track side.

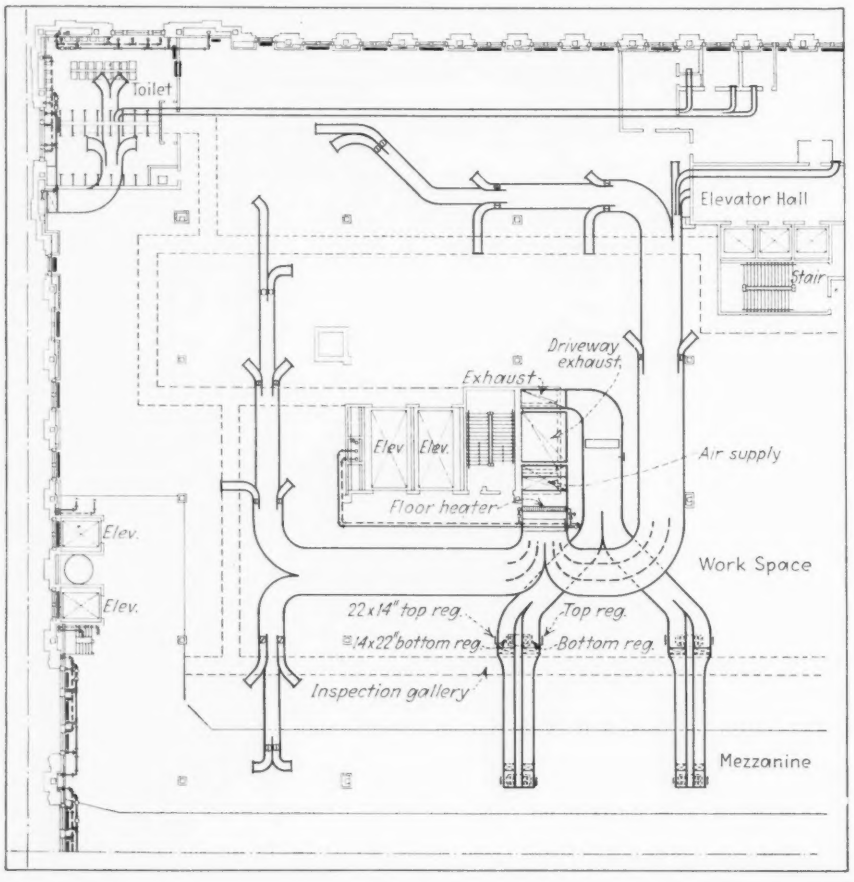
In general there is one enormous work room on each floor, with inclosures of only relatively small areas (such as required for offices, toilets, elevator shafts and the like). Because of this, control of ventilation supply air after it leaves the supply outlet is difficult. To guide it to as great extent as possible, all general supply is delivered from overhead ducts around the outside of the building and all general exhaust is removed from the central portion of the building. With this method, outside air entering through open windows in the summer naturally mingles with the supply air and follows the general air movement toward the center of the building, whence it is removed by the exhaust outlet.

On several of the floors, inspection galleries about 4 ft. wide are hung down from the ceiling for a distance of 8 to 10 ft., causing a ceiling pocket in the central portion of the building. This condition was counteracted by using top and bottom exhaust grilles.

In designing the ventilation system, the building was divided along the axis lines into four quarters of approximately equal size. Each quarter was taken as a unit and independently ventilated in the general method illustrated in Fig. 1 which shows the northwest corner of the second floor. The other quarters are quite similar in scheme with only certain modifications as required by slight variations in floor arrangement.

General supply and exhaust fans and a toilet exhaust fan for each quadrant are grouped on the 5th Floor to make recirculation possible when desired and to permit addition of cooling at some later date. A layout of the southeast quadrant fan rooms is shown in Fig. 2, the three other fan rooms being quite similar. Supply air is taken in and exhaust air is discharged through different walls.

Fig. 1—Arrangement of general ventilation in northwest quarter



Four-speed motors running on the three top speeds drive general supply fans, general exhaust fans and condensation cooling fan through V belts. Thus these may be used to supply 100, 75 or 50% of the maximum amount of air.

From the fan rooms, where the air is cleaned, heated, and humidified by cast-iron air heaters and 13-ft.-6-in.-long air washers, the air is carried down vertical shafts and is distributed horizontally on the ceilings of the various floors after passing through heaters at each floor, which take care of variations in temperature requirements of the different floors.

Quantity of Air Provided

Based on an estimated building occupancy of about 8,000 persons with a possible 25% increase for holiday rush, the maximum number of occupants is in the neighborhood of 10,000 which at 30 cu.ft. of air per minute amounts to 300,000 c.f.m. or 75,000 c.f.m. on each of the four supply fans. On the person basis this may seem excessive, but with 15,000,000 cu.ft., in the building it pro-

LARGEST POST OFFICE

By Harold L. Alt
Gibbs & Hill

vides only about 1⅓ air changes an hour, which it was considered unsafe to reduce.

Air removal is accomplished by four exhaust fans, one in each quadrant, which take out 75% of the supply air, less that removed by the toilet and other exhausts with the exception of the driveway exhaust.

A schedule of the supply and exhaust fans installed with their capacities and other features is given in the table. The capacity of the fans installed in each case is 10% above the estimated requirements.

The outside air damper in each of the four main fan rooms and through which make-up air is taken is constructed in two sections; one section has 40% of the total area and the other section 60%. The 40% portion is expected to remain open at all times, but is pneumatically operated by means of a manually controlled switch so that this damper may be closed if the apparatus should be shut down for any extended period. Under normal operation, however, this damper will be open under all conditions. Air motors controlled from a graduated thermostat in the outlet of the air washer throw open the 60% damper section when the air coming from the washer exceeds 60 deg.

Both the free exhaust damper, and the recirculation damper after the air washer, are controlled from this same thermostat and move at the same time as the fresh-air damper. Both of these dampers, however, operate as a single unit and the free exhaust opens and closes in parallel with the fresh air damper while the recirculation damper after the washer works in opposition to the other two. Thus when recirculation (with the preheater shut off) produces too high air temperature at the washer outlet (i.e., 62 deg. or over) the flow of recirculation air into the system is stopped altogether, 100% outside air is used, and all the exhaust air is discharged outdoors.

The recirculation damper before the washer is operated by air motors controlled from a second graduated-type thermostat in the air washer outlet, which closes off this damper whenever the air delivered by the washer exceeds 53 deg.

A thermostat in the fresh-air intake is set to turn steam into this first preheater section whenever the outside temperature falls below 35 deg. and thus protects the air washer against freezing. The second section of the preheater is controlled from a thermostat in the air-washer outlet which is set to turn steam on whenever the air delivered by the washer falls below 52 deg.

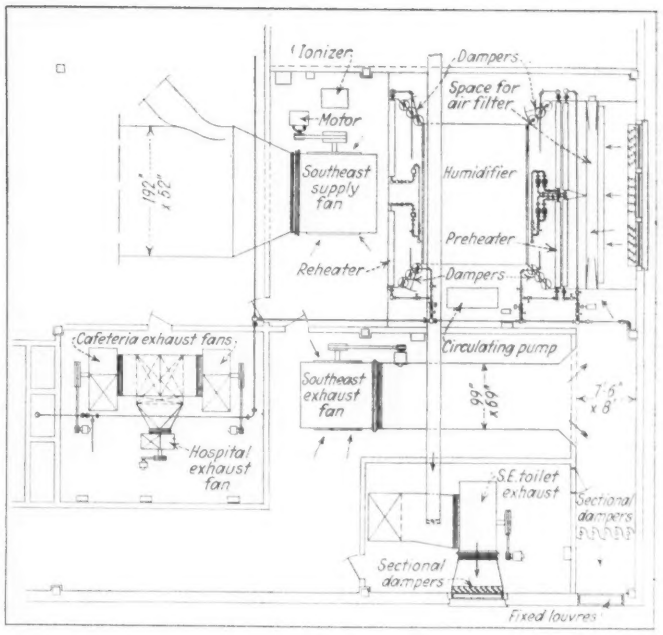


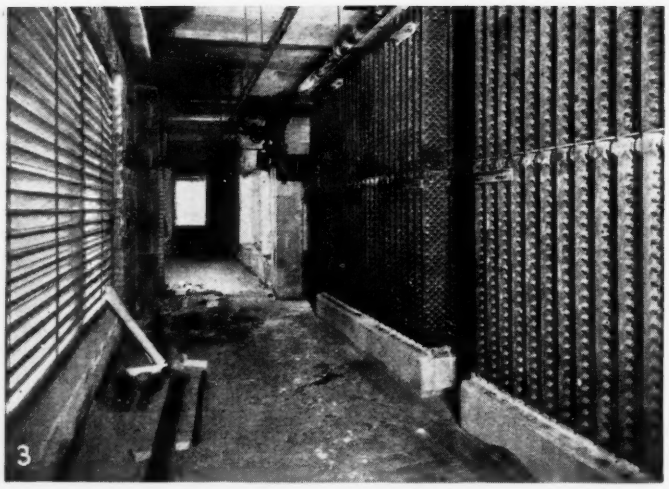
Fig. 2—All general ventilating fans are on the 5th floor in four groups, of which this is one

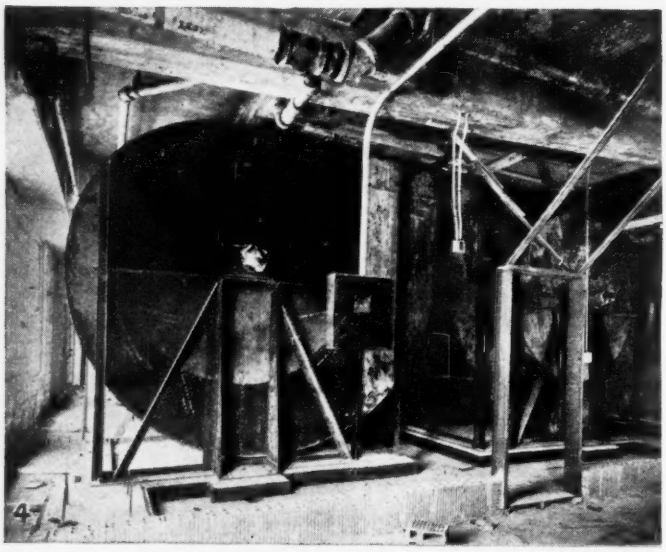
Control for the reheater is derived from a thermostat in the duct at the fan discharge and is set to turn steam into this heater whenever the air delivered to the building falls below 60 deg.

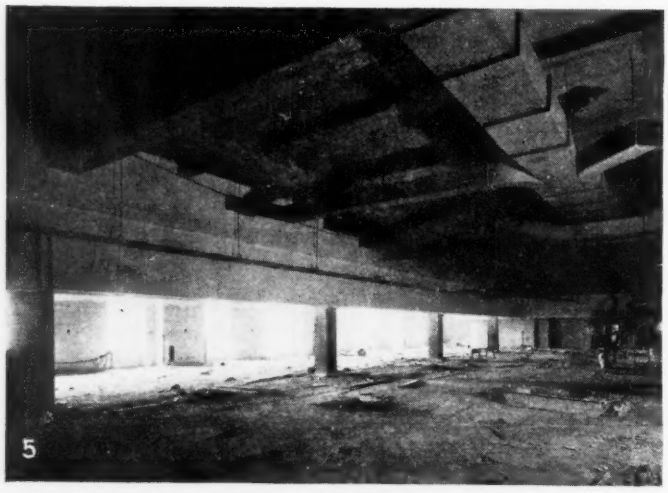
All air delivered from the four sets of general supply fans is assumed to be delivered to the main supply flues at or about 60 deg. As it enters the horizontal distribution ducts for each floor it passes through a floor heater, which either permits the 60-deg. air to be delivered to the floor space without change if the space is overheated, raises the air to 70 deg. if the temperature in the space is correct, or raises the air to 80 deg. in case the space is slightly below the proper temperature. Thus air may be delivered to any floor level in any quarter of the building at a temperature anywhere between 60 and 80 deg. according to requirements of

Supply and Exhaust Fan Data

	Number	Fan Capacity C.F.M. (68 deg. F.)	Static Pressure, In.	Max. r.p.m.	Max. Outlet Vel.	Operating B.Hp. Not To Exceed	Max. hp., Any Condition	Fan Weight (Min.), Lb.	Motor Hp.	Speed, r.p.m.
Supply Fans										
Condensation Cooling	1	110,000	1½	286	1,580	37.60	39.00	13,000	40	900
General	4	82,200	1¼	365	1,770	35.7	40.3	6,500	40	1,200
Mail Lift	8	6,050	½	556	1,580	0.92	0.96	650	1	1,800
Passenger Elevator	2	4,084	½	650	1,190	0.56	0.62	500	¾	1,800
Freight Elevator	2	2,520	½	753	1,050	0.36	0.37	400	½	1,800
Exhaust Fans										
Driveway	8	65,700	½	170	1,250	9.22	9.7	9,700	10	800
General	4	47,300	½	223	1,150	6.15	6.65	6,500	7½	1,200
South East Toilet	1	27,500	½	242	1,170	4.0	4.1	3,700	5	1,200
North West Toilet	1	13,700	½	315	1,050	1.75	1.80	1,900	2	1,200
Cafeteria	2	16,500	½	306	1,200	2.28	2.42	1,900	3	1,200
North East Toilet	1	13,700	½	315	1,050	1.75	1.80	1,900	2	1,200
South West Toilet	1	7,600	½	420	1,050	0.95	1.03	1,050	1½	1,800
Hospital	1	4,900	½	461	1,110	.053	.056	650	¾	1,800
Refrigeration Room	1	1,850	½	690	2,100	0.475	0.60	.....	½	690







that particular section. Operation of the floor heater for each quadrant is controlled from a thermostat located in the duct through which the exhaust air for that particular portion of the building is passing. This is regarded as the best point at which to secure an average temperature for the entire quarter section of the building, being supplied by each group of equipment.

The enclosed driveway on the ground floor level with entrance on 33rd. St., and on Ninth Ave., and in which 100 motor trucks may be loading or unloading at one time, provided food for considerable ventilation thought. Based on experiments made at the time of constructing the Holland Vehicular Tunnels, it was assumed that the concentration of carbon monoxide in the air in this driveway should not exceed 2 parts in 10,000 and that each truck when its engine is idling, will add about 100 cu.ft. of CO per hr. Also that of 100 trucks 50% might have their engines running. On this basis the cubic feet of air required per hour would be 50 x 100 x 10,000/2 or 25,000,000 cu.ft. per hr., which is 416,000 c.f.m., say 500,000 c.f.m. for safety and this amount divided among 8 fans gives 62,500 c.f.m. for each fan. Division into 8 units allows any proportion of the total ventilation to be supplied in progressive 12½% steps.

Two driveway exhaust fans are installed in each quarter of the building and air is taken off of the driveway throughout its entire length in approximately equal quantities at the floor and at ceiling.

Some air supply is furnished to the driveway by unit heaters using heating system condensate but this amounts to only 100,000 c.f.m. aganist 500,000 c.f.m. removed by the exhaust, leaving a balance of 400,000 c.f.m. to come in through the entrances where it is tempered by the unit heaters previously described.

Considerable heat is developed in the elevator machine rooms, this being estimated as follows:

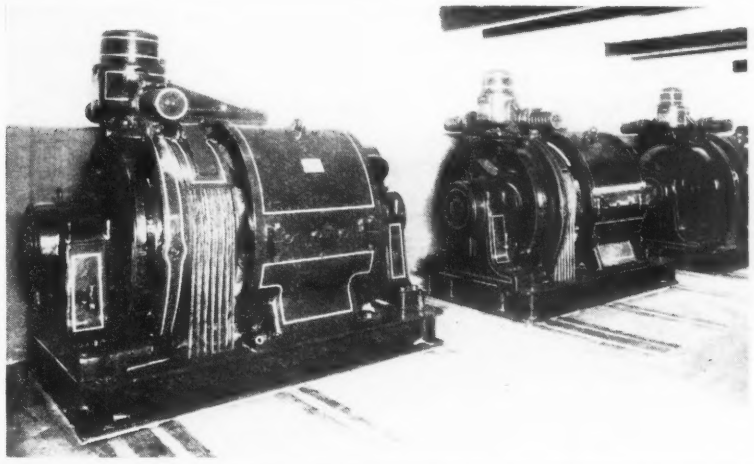
	Total B.t.u./hr. Each Machine Room	Ventilating Air, C.F.M.
Passenger cars, 3 at 27,000 B.t.u. per hr.	81,000	7,425
Freight cars, 2 at 25,000 B.t.u. per hr.	50,000	4,582
Mail lifts, 2 at 60,000 B.t.u. per hr.	120,000	11,000

Air requirements were calculated on the basis of a 10-deg. rise above outside temperature. Air is relieved from the room through exhaust grilles provided with aluminum check dampers, which open automatically whenever the fans start up and increase the air pressure in the room.

This building was designed for the U. S. Government by McKim, Mead & White, Architects, New York, and the structural steel, mechanical work and electrical work were designed by Gibbs & Hill, engineers, New York. An article in the August number will describe the heating system installed.

Fig. 3—Fresh-air inlet is at the left, and exhaust outlet in the background serves one set of general ventilating fans. Fig. 4—Two of the eight exhausters for the driveway. Fig. 5—Typical floor showing inspection gallery. Fig. 6—An unusually wide duct for driveway exhaust can be seen at the ceiling

Quality of elevator service is one of the most important factors in building operation. Here is a simple method for measuring it by taking car-arrival times at terminal landings



How to MEASURE ELEVATOR SERVICE

By K. M. White

Elevator Engineer, New York, N. Y.

GOOD elevator service demands primarily that passengers can get on a car promptly after they press a landing button. Once they are on the car, they are less impatient. Economical operation requires that reasonably good service must be maintained with the least number of cars, efficiently dispatched. It is important to the building's reputation and cost of operation for the management to know how good the service is and whether the starters are working efficiently. The usual methods of obtaining this information, however, are tedious and require considerable time.

A method has been developed, however, that makes it possible for one person to obtain an accurate picture of the service in a short time. It has been thoroughly tested under all conditions and found to be accurate and consistent whenever the cars are regularly dispatched. It is not intended to be used when the cars simply wait for a signal to show on the annunciator, then answer the call.

The quality of service will be well known if the following three elements are measured:

1. Interval of departure from the main floor.
2. Average waiting time of passengers on the upper floors.
3. Maximum waiting time of passengers on the upper floors.

The interval of departure from the main floor is the average number of seconds between the departure of successive cars. For average office buildings, the service will be good if a car leaves every 30 sec. If the amount of traffic is exceptionally heavy or light, the interval should be a little less, or somewhat longer accordingly. With heavy traffic, the cars will not remain so evenly spaced during the entire trip. The waiting time of passengers to come down from the upper floors is therefore likely to be longer for a given interval of departure.

Average waiting time of passengers on the upper floors is the probable number of seconds a passenger will have to wait for a car to arrive after pressing the signal button. It depends on the interval of departure from the main floor, and on the even spacing of the cars throughout the trip.

There will be times when a passenger will just happen to miss one car, and will have to wait longer than usual for the next car. If the next car happens to be late, the wait may be excessive. For good service, this maximum waiting time should not be permitted to exceed about 60 sec.

Using the Law of Probabilities

How passenger waiting time may vary at the intermediate floors will be evident from Figs. 1 and 2. In Fig. 1, let the scale represent time in seconds. Assume that four elevators pass an upper floor, traveling in the down direction, at the times shown. They are equally spaced, with an interval of 30 sec., an ideal condition. Also, assume that on the average, a passenger will wish to go down from that floor every 10 sec. at the times represented by A, B, C, etc. *A* has missed car No. 1, and will have to wait 25 sec. for No. 2; *B* has to wait 15 sec.; *C*, 5 sec. The remaining waits for cars Nos. 3 and 4 will duplicate these, and the average of all the waits will be 15 sec., or exactly half the interval of departure.

In Fig. 2, the same average interval of 30 sec. is

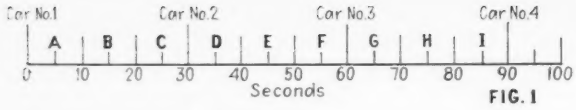


FIG. 1

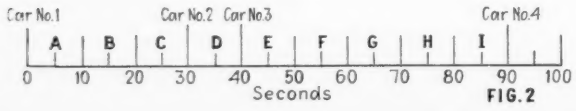


FIG. 2

NUMBER OF CARS RUNNING _____ BANK _____

TIME OF DAY _____ DATE _____

N	Car No.	Arrival	W	W^2
0	1	54:36		
1	2	54:50	14	196
2	3	55:49	59	3481
3	4	56:01	12	144
28	4	7:30	31	961
29	5	7:54	24	576
30				
Total			798	30,484

Interval of departure $= \frac{\text{Total W}}{\text{N}} = \frac{798}{29} = 27.5$ seconds

Average waiting time $= \frac{\text{Total W}^2}{2 \times \text{total W}} = \frac{30,484}{2 \times 798} = 19.1$ seconds

Maximum waiting time = 59 seconds

Figs. 1 and 2 (top)—Diagram of floors and position of cars. Fig. 3—Form on which to record data for measuring elevator service

shown, but with an uneven spacing. This is more likely to occur in service, because some cars usually make more stops on a given trip than others. Taking the condition of a passenger coming every 10 sec., as before, the waits will now be: *A*, 25 sec.; *B*, 15 sec.; *C*, 5 sec.; *D*, 5 sec.; *E*, 45 sec.; *F*, 35 sec.; *G*, 25 sec.; *H*, 15 sec.; and *I*, 5 sec. The average of these waits is 19.44 sec., as compared with 15 sec. before, although the average interval of departure has not been changed. Thus it is seen how the average waiting time depends on both the interval of departure and the spacing of the cars. It will always be more than half the interval of departure, and will be greater as the cars are more unevenly spaced.

If a passenger just misses No. 3 car, Fig. 1, he must wait 30 sec. for No. 4; but in Fig. 2, he must wait 50 sec. This will be the maximum upper floor waiting time in this case.

These examples show the principle involved. A general method to be used in any case has been developed and is given in the following:

Let T be the total number of seconds during which the time each car goes past a given floor is noted. Let W_1, W_2, W_3, etc., be the number of seconds between cars throughout the period T. The sum of W_1, W_2, W_3, etc. will then equal T. The average waiting time t of all passengers who go down from the floor during period T may be obtained by the formula:

$$t = \frac{W^2_1 + W^2_2 + W^2_3, \text{ etc.}}{2\,(W_1 + W_2 + W_3, \text{ etc.})}$$

Thus, it is seen that the W's, the time between successive cars, are the only data which need be taken to obtain all the information desired. As a car makes a trip, it is likely to get more unevenly spaced from the others near the end of its trip, or as it approaches the main floor coming down. Therefore, to be sure the worst conditions of upper floor waits are obtained, the W's may be obtained by timing the arrival of the cars at the main floor. Spacing between their arrivals will be approximately the same as their spacing when they passed the lowest stop on the way down. This will give the down conditions of upper-floor waits, which are usually the only ones of much importance. In cases where up traffic is heavy from the various floors, the same data may be taken at the top floor.

To obtain the time interval between cars, all that is necessary is for one person to stand at the terminal floor with paper, pencil and a watch with a second hand, and write down the time of arrival, in minutes and seconds, of each car. A period of 15 or 20 min. is sufficiently long for timing the cars to get consistent results. It is desirable to take the same data during various times of the day, such as morning, noon and night rush, and non-rush periods. Usually this can be done in the machine room by timing the arrival of the selectors at the main floor. This has the advantage that the starter and operators will not be aware that a test is being made, and will not put on a "show" performance.

If a considerable amount of "by-passing" or "non-stop" running is done, then this should be taken into consideration by making a check mark opposite the time recorded for each car which was by-passing signals on that trip. This information usually must be obtained on the main floor. Then, when making the calculations, the arrival time of these cars is considered in working out the interval of departure, but is omitted when working out the average and maximum waiting times.

Data Form

For convenience in taking the data and making the calculations, a form, Fig. 3, may be used. Such forms can be multigraphed in quantity at little cost. Hold the watch in one hand, or attach it to a data board which holds the form conveniently. The time of arrival of each car is entered under the column headed arrival: the hour need not be used here. Twenty-five or thirty readings are usually sufficient to give a good average. It is well to enter the car number with each reading, as this will show if one car is consistently late. The calculations are then made thus:

Subtract each time of arrival from the next following one, to obtain each W, and enter them as shown. Keep in mind that in subtracting time in minutes and seconds, when a number has to be "borrowed" from the minutes to the seconds, it becomes sixty instead of ten, as in ordinary subtraction with the decimal system. The total of all the W's should be the same as the total time obtained by subtracting the first time of arrival from the last. This may be used as a check on the subtraction. The square of each W is then entered in the W^2 column. A table of the squares of numbers to 100 is given,

Squares of Numbers From 1 to 100

W	W^2	W	W^2	W	W^2	W	W^2	W	W^2
1	1	21	441	41	1,681	61	3,721	81	6,561
2	4	22	484	42	1,764	62	3,844	82	6,724
3	9	23	529	43	1,849	63	3,969	83	6,889
4	16	24	576	44	1,936	64	4,096	84	7,056
5	25	25	625	45	2,025	65	4,225	85	7,225
6	36	26	676	46	2,116	66	4,356	86	7,396
7	49	27	729	47	2,209	67	4,489	87	7,569
8	64	28	784	48	2,304	68	4,624	88	7,744
9	81	29	841	49	2,401	69	4,761	89	7,921
10	100	30	900	50	2,500	70	4,900	90	8,100
11	121	31	961	51	2,601	71	5,041	91	8,281
12	144	32	1,024	52	2,704	72	5,184	92	8,464
13	169	33	1,089	53	2,809	73	5,329	93	8,649
14	196	34	1,156	54	2,916	74	5,476	94	8,836
15	225	35	1,225	55	3,025	75	5,625	95	9,025
16	256	36	1,296	56	3,136	76	5,776	96	9,216
17	289	37	1,369	57	3,249	77	5,929	97	9,409
18	324	38	1,444	58	3,364	78	6,084	98	9,604
19	361	39	1,521	59	3,481	79	6,241	99	9,801
20	400	40	1,600	60	3,600	80	6,400	100	10,000

which may be used to save much multiplying. This column is then totaled. If an adding machine is available to do the job, the work of totaling the W's and W^2's will be greatly simplified.

The interval of departure is obtained by taking an average of all the W's, that is, dividing the total of the W's by the number of W's, which is the figure in the N column opposite the last observation taken. The average upper-floor wait is the total of the W^2 column divided by twice the total of the W's, which is the same as the formula previously worked out. The maximum upper-floor wait is simply the largest W in the column. It should be understood that this maximum wait is the maximum possible. A passenger does not always just miss the previous car and have to wait this full time. This value is therefore a true measure of how good, or rather, how bad the service is, whether a person happens to come at just that time or not. Unfortunately, the most imporant person in the building might be trying to catch a train just then, as so often seems to be the case.

Records of this kind taken at regular intervals, on each bank of elevators at rush and non-rush periods of the day, will be a valuable addition to the files of a building, and they may be obtained at little cost. Instead of guessing or estimating that the service here is bad, and there fairly good, an exact measurement is made.

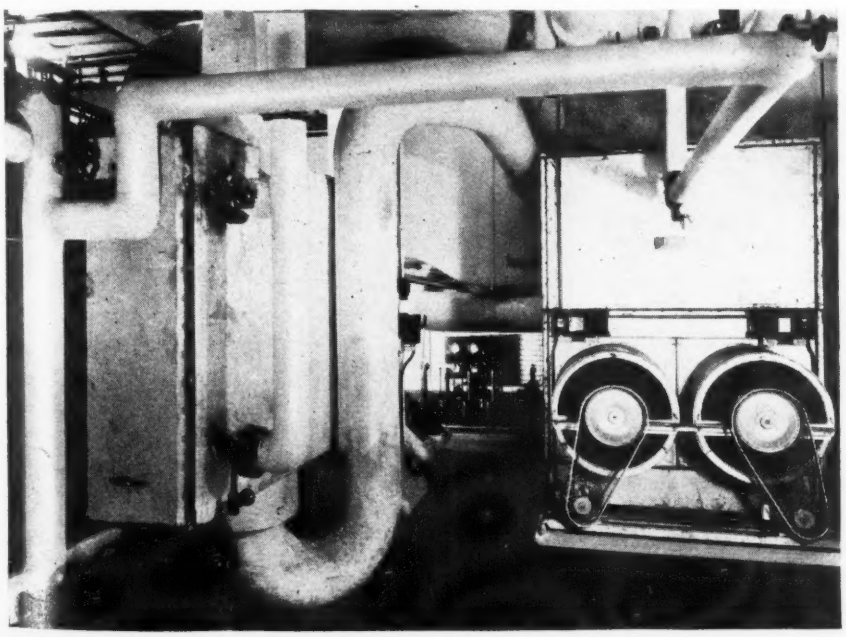
When dispatching is done manually by starters, the work of the various men can be accurately measured. If automatic dispatchers are used, the most efficient adjustment in each case can be determined. The fastest setting is not always best (although in practice it will approach that); the effect of heavy traffic on car spacing will influence it. Changing traffic conditions or riding habits of the building's population will be indicated if regular records show a change from time to time.

Studies made in this way are a measure of the service rendered to the passengers, and are not intended to be a traffic study. The latter is a measure of the amount and habits of the traffic. When it is found that the service is unsatisfactory, then a check on traffic should be made to find out the causes, if proper adjustment of dispatching does not remedy the trouble.

If the cars are equipped with mileage recorders and stop counters, the number of stops per mile, computed every month, will be an excellent check on how busy the elevators are. This information, together with a measure of the service, will indicate whether the elevators are doing what they should. Obtaining this information involves very little expense.

Do You Operate Boilers?

IF SO, watch for August *Power*, where there will be presented the first of several chapters of Frank H. Browning's book "Steam Plant Errors." This man has the rare gift, perfected through long experience as an engineer examiner, of educating by questions. No matter how well you think you understand boiler operation, read Browning's dialogues for new light on old problems.



Basement Cooling Tower

Rarely has a cooling tower been installed indoors in an office building basement. It is entirely practical and possible. Singer Bldg., New York skyscraper, has this 90-g.p.m. Binks indoor spray-type tower for partial cooling of jacket water to its new diesel (*Power*, June, pages 299-301). A 75-g.p.m. Gould pump (center rear) forces water from the tower into the discharge header of the 150-g.p.m. cooling-water pump to supply jacket water at 130 deg. Air is forced through the tower by the two fans driven by 3-hp. shunt motors, then out into the flue beside the boiler stack. At left is a Foster-Wheeler exhaust-gas water heater through which diesel exhaust may be bypassed for heating boiler feedwater to as high as 355 deg. F. It is protected by a pop valve set at 190 lb. Piping is all-welded and high-temperature insulated.

TEST YOUR OWN BOILERS—II

By Walter H. Wood

Combustion Engineering Co., Inc.

This second article explains how to handle fuels in a simple boiler test that any operating engineer can make. Last month Mr. Wood gave general data; next month he will discuss methods of collecting and preparing samples of fuels and ash-pit refuse

FUELS most commonly used for steam-generating purposes are coal, coke, oil, and gas. When tests are made of units fired with coal or coke, fuel should always be weighed on a sensitive, calibrated scale, because volumetric measurements of solid fuels are not reliable. Amount of fuel oil used on a test can be determined either by weight or by volume. In tests of gas-fired units, the quantity of fuel used is measured by venturi or orifice meter.

Fuels used on a test should be weighed as near the point of use as is convenient to avoid possible loss of fuel. The scale on which the fuel is weighed should be sensitive throughout its entire range and should be calibrated just before starting the test. If the scale beam is sluggish in movement, accurate results can hardly be expected. Weighings should be made with the beam always in the same position, preferably when it is about midway of its up-and-down travel. An accurate balance should be made at each weighing. It is not safe to count on over-weights and under-weights balancing each other over a number of weighings.

If weighing of the fuel is done in quantities that will permit ascertaining the amount burned each hour, approximate results can be calculated while the test is in progress, and it will be possible to finish the test at the end of any hour, in case of necessity.

Steam-generating units that use coal or coke for fuel may be fired by hand, by stokers, or by pulverized-fuel equipment. The fuel burned on hand-fired units is usually piled at a convenient distance in front of the firing doors. Stoker hoppers may be filled by shoveling fuel from the floor, or the fuel may be delivered to the hoppers through chutes, or by larry.

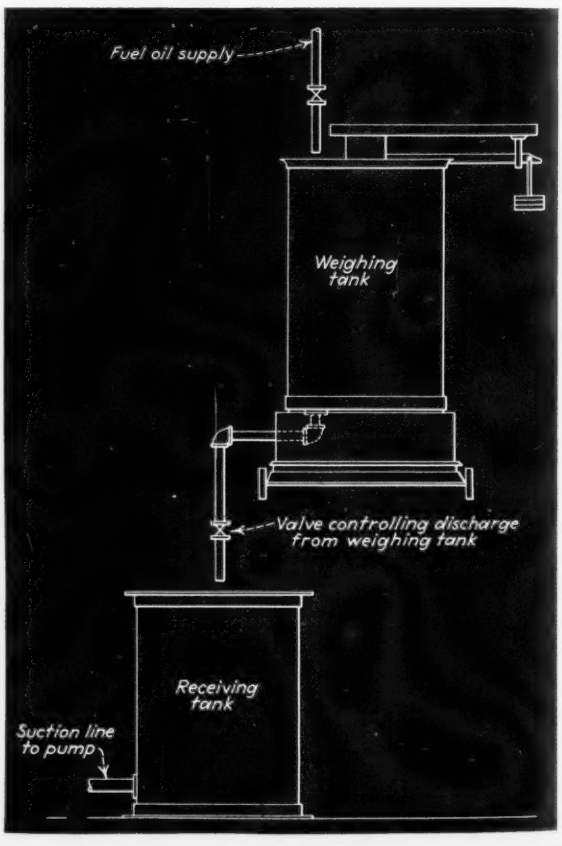
If fuel is to be shoveled by hand, either into the furnace or into the stoker hopper, the floor in front of the unit should be cleared of anything that might interfere with piling the weighed fuel. Often it is advisable to enclose with boards set on edge the space to be occupied by the weighed fuel. The scale should be placed in a convenient location, and runways provided on each side of the scale platform. Fuel can be weighed and delivered for firing most conveniently in a wheelbarrow. A net weight of 250 lb. of coal can usually be loaded in a wheelbarrow, weighed and emptied on the firing floor in 3 to 4 min. It is possible, therefore, to handle 1½ tons of fuel an hour with one wheelbarrow.

The scale platform should be large enough to accommodate the wheelbarrow, or else an extension platform should be placed on the scale. Before balancing each wheelbarrow of fuel, sweep the platform clean, and do not allow fuel to accumulate on the floor around the scale. Care should be taken to see that each barrowful is entirely emptied. If the fuel is wet, the barrow should be swept clean or else a tare weighing should be made after emptying each load.

Weighing and recording of fuel weights should be done by one man, and loading, wheeling and unloading by another. To avoid errors in the record, the time the barrow of fuel is removed from the scale platform and placed on the floor should be recorded to the nearest minute. Keep the record clean and legible and in a note book or on a pad, not on loose sheets of paper. Fuel weighing is one of the most important factors in making a test.

If the fuel burned on a test is weighed by an auto-

Fig. 1—Tank arrangement for weighing fuel oil



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matic scale or a weigh larry, accuracy of the scale should be determined by calibration. If standard test weights are not available, calibrations should be made by emptying the amount of fuel weighed by the scale into a suitable container on an accurate platform scale. Four or five such calibrations should be made. If the gross and tare weights made on a weigh larry are stamped on "tickets," the time of weighing should be noted on the card, and an independent record of time and gross and tare weights kept by the observer. A typical record of fuel weighing is shown in Fig. 3.

Weighing fuel used on tests of pulverized-fuel-fired units depends upon the type of firing employed. In the case of a bin or storage system, where a single bin is used the fuel can be lowered to a grating placed near the bottom of the bin and the test then started. The amount of fuel necessary to operate the unit for the duration of the test is weighed, pulverized and delivered to the bin, and the test is ended when the fuel level in the bin again reaches the grating. Such a method is somewhat hazardous, requiring one or more men in the bin for leveling the fuel. Mixture of air and fuel in the bin is often highly explosive. The method is not satisfactory where two or more bins are in use, as it is practically impossible to obtain a fuel level in two or more bins at the same time. It is usually more satisfactory to measure performance of pulverized-fuel units of this type by the heat-balance method. In making tests of pulverized-fuel units of the direct-fired type, fuel can be weighed in wheelbarrows or by larry or recording scales before it is delivered to the raw-coal hoppers.

The ash pit should be clean at the time the test is started, and all ash and clinker which accumulates in the pit during the test must be weighed and samples taken, if a heat balance is to be calculated. Clean the pit out a short time before the test is to be started, and

NAME OF PLANT.....

LOCATION OF PLANT.....

DATE OF TEST.....

UNIT TESTED.....

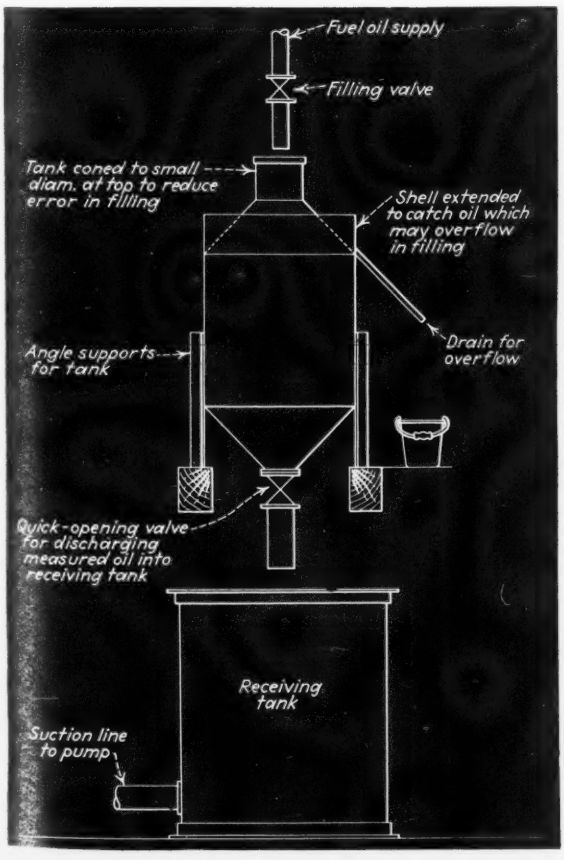
FUEL RECORD BY.....

TEST STARTED 8:00 A.M..... TEST FINISHED.....

Time	Weight of Fuel Gross	Tare	Lb. Net
8:04	378	120	258
8:09	381	120	261
8:11	380	120	260
8:16	382	120	261

Fig. 3—Typical record of fuel weights

then make a final cleaning just after the beginning of the test. Clean the pit at intervals during the test, usually just after the fire is cleaned in the case of hand-fired furnaces and stokers of the dump type. It is advisable to weigh ash and refuse dry when practicable. The scale used for fuel weighing can be used, although it is frequently necessary to use another scale and wheelbarrow. A record of weights of ash and refuse should be made, using a form like Fig. 3. A record of the weight of cinders carried out of the furnace and deposited in the setting and in the base of the stack should be made whenever possible, and samples obtained for analysis, especially if the various losses are to be accounted for by a heat balance. All large clinkers which result from burning the fuel should be broken down so that correct sampling of refuse can be done.


Fuel oil supply
Filling valve
Tank coned to small diam. at top to reduce error in filling
Shell extended to catch oil which may overflow in filling
Drain for overflow
Angle supports for tank
Quick-opening valve for discharging measured oil into receiving tank
Receiving tank
Suction line to pump

Weighing or Measuring Oil Used

The quantity of fuel oil used on a test can be determined either by weighing or by measuring in a calibrated tank. Weighing the oil is a reliable method, although more satisfactory results can be obtained by measurement if the measuring tank is of proper design.

One weighing tank and scale are often sufficient for determining the amount of fuel used on the test. Fig. 1 illustrates a convenient method of arranging the scale, tanks and piping. Volumetric measurements of oil can be made with a high degree of accuracy by a tank arrangement illustrated in Fig. 2. The upper tank is calibrated by filling until the tank just overflows, then weighing the contents. In using the tank on a test, the oil should be brought to the overflow point at each filling. Any fuel that spills over will drain away and can be recovered. The temperature of the oil should, of course, be taken when the tank is calibrated and also while the test is in progress.

In making tests of gas-fired steam-generating equipment, fuel used should be measured by a venturi or orifice type meter. Other types of meters are usually not reliable.

Representative samples of all fuels used in making evaporative tests should be obtained for laboratory analysis. A succeeding article will describe methods of collecting and preparing samples of fuels and ash-pit refuse.

CHEMICAL DEAERATION

In June Mr. Powell summed up the facts. Here is their application, practical instructions for the use of sodium sulphite to remove oxygen from boiler feed water.

THE deacration of boiler water with sodium sulphite is not a new development; it has been practiced for some years, but has attracted attention recently because its functions have filled a need arising from the use of modern steam-generating equipment. One producer of the chemical estimates that the amounts used for this purpose were small in 1932, fifty tons in 1933, and 250 tons in 1934.

Supplements Physical Deaeration

The applicability of sodium sulphite is not universal, but will depend on the specific operating conditions encountered. It should be understood that chemical deaeration may not replace contact or deaerating heaters. When such devices are unable to deliver water containing less than 0.15 milliliters of oxygen per liter, chemical methods make a complete removal possible and fill a read need. Moreover, in high-pressure installations, even though the effluent from the deaerating heater may show "zero oxygen" by the Winkler test, the cumulative effect of this residue of less than 0.01 milliliter per liter of oxygen may be sufficiently serious to justify its complete absorption by sulphite. If steel-tube economizers are used, serious corrosion can only be prevented by removing oxygen entirely from feed water before it enters the economizers.

Use of sodium sulphite may be limited in some cases by the permissible total solids, although when a consideration of the above factors indicates that chemical deaeration is needed it should be remembered that the reacting portion of the sulphite is a source of the sodium sulphate required to inhibit embrittlement. Each pound of sodium sulphite that absorbs oxygen furnishes 1.12 lb. of sodium sulphate. In practice it will be found that the feeding can be regulated to maintain the required excess of each chemical.

How to Feed Sulphite

Sodium sulphite may be fed at the heater or suction of the feed pump, at the discharge of the feed pump, or directly into the drum of the boiler. It may be fed continuously or intermittently, but where economizers are used, continuous feed is required for their protection. In general, it is desirable to add a small variable quantity of sulphite to a constant stream of water entering the system, since great dilution of the sulphite is required to obtain the doses that are necessary.

This may be accomplished by the simple and inexpensive feeder shown in the diagram, which is applicable when the solution can enter the system by gravity or against a moderate head. The large tank and the air washer attached to it are filled with a 15 to 20% solution; this feeds through a needle valve into a constant stream of condensate. Any standard chemical feeder may be used, but if exposed to air it should be made of cast iron or other resistant material.

Quantity Required

The quantity of sodium sulphite required may be calculated from the oxygen content of the water to be treated. Theoretically, 126 parts of sodium sulphite react with 16 parts of oxygen. It is customary to correct for 90% purity and 75% efficiency, and when conversions are made to the customary units, this gives the following required dose:

POUNDS OF COMMERCIAL SODIUM SULPHITE REQUIRED

	Per 1,000 lb. of feed water	Per 1,000 gal. of feed water
For each part per million dissolved oxygen	0.0117	0.097
For each milliliter per liter dissolved oxygen	0.0168	0.139

Although the above doses are related to dissolved oxygen, the treatment cannot be controlled by determining the oxygen content of the heater effluent or of the feed water after addition of sulphite. The limitations of the Winkler method when applied to physically deaerated water have been mentioned above, and the determination of oxygen in the presence of sulphites is difficult and not to be recommended except for special studies. *Therefore, it is preferable and perfectly adequate to analyze the concentrated boiler salines for sodium sulphite, and adjust the feed to maintain an excess of 20 to 50 parts per million. Experience indicates that these amounts will afford protection against corrosion.*

Analytical Control

The test for sodium sulphite is a well-known standard procedure, utilizing the reagents of the Winkler titration and in addition a solution of iodine of approximately the same strength as the thiosulphate. Exact procedure is:

Sodium sulphite is determined by the iodimetric procedure of adding a measured quantity of the freshly drawn cooled sample to an excess of standard iodine

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The article (here concluded) is abstracted from the forthcoming second edition of Mr. Powell's book, "Boiler Feed Water Purification." All rights reserved by the author.

OF BOILER FEED WATER

No. 2—PRACTICAL APPLICATION

By Sheppard T. Powell

Consulting Chemical Engineer, Baltimore, Md.

solution, which is reduced by the sulphite. The remaining iodine that has not reacted with the sodium sulphite is then titrated with a standard solution of sodium thiosulphate, using starch as the indicator.

From a pipette, measure 10 ml. of N/40 iodine solution and 5 ml. of glacial acetic acid into a clean white casserole. Then add slowly with stirring 100 ml. of sample which has been cooled to room temperature. This sample should be cooled as drawn, and filtering or other exposure to the air should be avoided prior to making the determination. To this mixture, while stirring with a glass rod, add the N/40 sodium thiosulphate solution from a burette until the brown color of the iodine is almost gone. Then add 2 ml. of starch indicator solution and continue to add the sodium thiosulphate until the blue coloration, due to the starch iodide, disappears. Record the number of ml. of sodium thiosulphate used from the burette, under the symbol *S*.

Repeat the foregoing procedure, using 100 ml. of tap or distilled water, free from sulphite, in place of the sample. Record the number of ml. of sodium thiosulphate used under the symbol *W*.

Since the amount of sodium thiosulphate used in the blank determination using sulphite-free water, less the sodium thiosulphate used in the sample, represents the equivalent of the sodium sulphite in the sample, then:

(*W* Reading — *S* Reading) × 15.8 = p.p.m. of sodium sulphite.

EXAMPLE:

Suppose the *W* reading is 10.2 ml. and the *S* reading 8.7 ml., then

(10.2 — 8.7) × 15.8 = 23.7 p.p.m. sodium sulphite in the sample.

The following reagents are required:

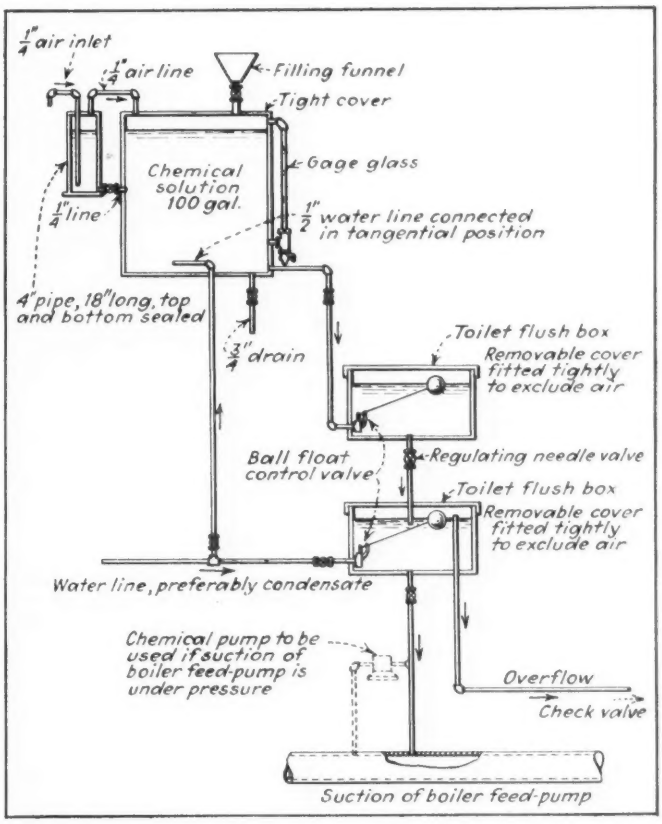
(1) Glacial Acetic Acid.
(2) Standard N/40 Iodine solution.
(3) Standard N/40 Sodium Thiosulphate solution.
(4) Starch Indicator solution.

Reagents (3) and (4) may be the same solutions that are required for the determination of dissolved oxygen by the Winkler Method.

Protecting Idle Boilers

During recent periods of decreased production, much damage has been done to steam-generating equipment when it has been necessary to keep boilers filled with water for stand-by service. In particular, damage has resulted from brief shutdowns over week-end periods of reduced load. Under such conditions air is drawn into the boiler and dissolves rapidly in the water. A contributing factor is the lowering of alkalinity by the condensation of steam and entrainment of carbon dioxide.

This may be remedied by filling the boilers completely, maintaining an excess of sodium sulphite to absorb oxygen, and keeping the pH at a minimum of 10.6 by additions of caustic soda solution if necessary. If the feed water is being treated with sulphite, the pump may be operated, after the boiler has been dropped, at a reduced rate just sufficient to balance the contraction of the boiler water and to fill it completely when cold. If this procedure is not feasible, a large dose of the sulphite may be added just before dropping the boiler from the line. The water should be tested periodically for sodium sulphite and pH, and, if necessary, additions should be made to maintain the specified limits.


1/4" air inlet
1/4" air line
Filling funnel
Tight cover
Chemical solution 100 gal.
Gage glass
1/4" line
1/2" water line connected in tangential position
4" pipe, 18" long, top and bottom sealed
3/4" drain
Toilet flush box
Removable cover fitted tightly to exclude air
Ball float control valve
Regulating needle valve
Toilet flush box
Removable cover fitted tightly to exclude air
Water line, preferably condensate
Chemical pump to be used if suction of boiler feed-pump is under pressure
Overflow
Check valve
Suction of boiler feed-pump

Arrangement for continuous feed of a diluted solution of sodium sulphite to prevent oxygen corrosion of boilers and steel-tube economizers

CONSTANT-LEVEL OILERS GIVE LUBRICATION INSURANCE

Hand oiling is synonymous with feast-or-famine lubrication. It is not so sure as automatic oiling, and may cost more in oil and repairs. Here are shown examples of one type of automatic lubricators

WHEN bearings are lubricated from a self-contained reservoir, it is necessary that the oil in the reservoir be maintained at a definite level for best results. With hand lubrication, when oil is put into the bearing the level is generally made too high, and before the supply is replenished the level is too low. To prevent this feast-or-famine method of lubrication, automatic methods have been devised to maintain constant oil level in the bearing reservoirs.

In its bad effects, too much lubricant is second only to too little. Lack of lubrication in a bearing may be due to neglect by machine attendants; dirt in bearings stopping up passage ways and thus preventing free circulation of the oil from and to the reservoir; syphoning oil from the reservoir by capillary action; bearing leaking for various causes, even to drain cocks being accidentally opened when machine is being cleaned; oil rings or chains stopped, due to dirt, wear or bending. Whatever the cause the effects are the same; worn and overheated bearings increase power costs and cause frequently unexpected bearing failures with their expensive delays and repairs.

Over-lubrication, due to flooding of bearings, may be caused by an overzealous attendant making sure that there is plenty of lubricant in the bearing; to carelessness or to bearings so constructed that oil level cannot be easily determined. Oil wasted from flooded bearings increases the difficulty of cleaning, creates a fire hazard, damages manufactured products, and causes accident hazards due to slipping if it drips on floors or other places where attendants must walk. A source of expense frequently overlooked is the deteriorating effect of oil on electrical insulation.

An investigation made by the Association of Iron & Steel Electrical Engineers showed that by keeping the oil in the bearing and off the windings, motor maintenance could be cut anywhere from 40 to 90%, depending upon the type of motor and its application. This feature alone gives the problem of correct lubrication of motor bearings outstanding importance.

Over-lubrication of sleeve bearings does not affect their efficiency. In an anti-friction bearing, if the oil is too high the balls or rolls create a pumping action which decreases bearing efficiency, increases oil temperature and may have a deteriorating effect upon the lubricant and bearing.

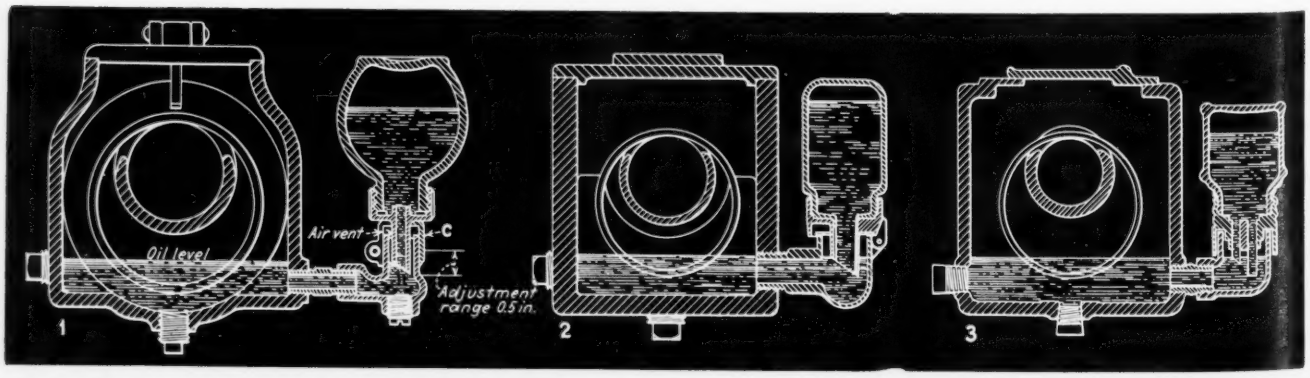
Types of Lubricators

Several types of devices have been developed to maintain a constant level in oil reservoirs of bearings, to bring the oil supply easily in sight of the attendant and to simplify the work of lubricating these bearings, one of which is shown in Fig. 7. The inverted glass bottle *B* is the oil reservoir sealed into base *A*. On the bottom end of the bottle is a metal cap to protect the glass and also act as a seal for the metal shutoff disk. When the bottle is filled it can be inverted and the disk valve prevents oil from running out until the bottle is in position.

Threaded stud *S* is supported in the bottom of the oil cup. A bar on this stud serves to adjust the oil level in the bearing. When the glass oil reservoir is put into place, stud *S* pushes the disk valve open and allows oil to flow into the cup until it rises to a level that seals the bottle against the entrance of air. The vacuum created in the bottle will then stop the oil flow. Height of the oil in the cup, consequently in the bearing, can be adjusted by turning the oil reservoir and with it the crossbar, which will raise or lower the cup on the threaded stud. When at the proper level, the reservoir is locked into place by the thumbscrew and locknut *N*.

In ring-oil bearings, the oil level should be adjusted so that it comes up well above the top side of the bottom of the ring. In an anti-friction bearing, the oil should be regulated so that it nicely touches the balls or rollers. As the lubricant is used up in the bearing, the seal on the oil reservoir is broken and oil runs from the reservoir to restore the level in the bearing.

Fig. 1—Single-feed-pipe adjustable oiler. Fig. 2—Non-adjustable type oiler. Fig. 3—2-pipe type oiler



A somewhat similar design is shown in Fig. 8. In this case the reservoir is sealed by a composition ball when it is removed from or is being returned to the oil cup. Oil-level adjustment is made by raising or lowering bar *B* on the threaded stud. When the adjustment is properly made the bar is locked into position by the cotter pin through the central tube and threaded stud.

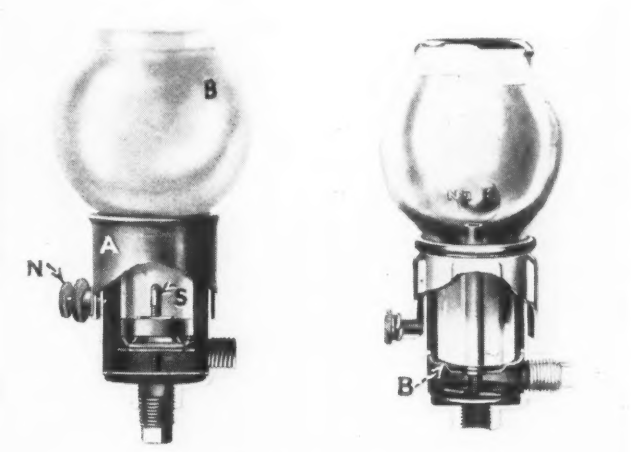
Another adjustable-type, constant-level lubricator is shown in Fig. 1. The glass reservoir is supported in a brass base with a bevel-ended shank that extends down into a tee fitting screwed onto a nipple in the motor bearing. Oil will flow from the reservoir into the bearing until a level is reached to seal the upper edge of the shank bevel, as indicated in the figure. As the oil is used up in the bearing, the seal is broken and the level is restored.

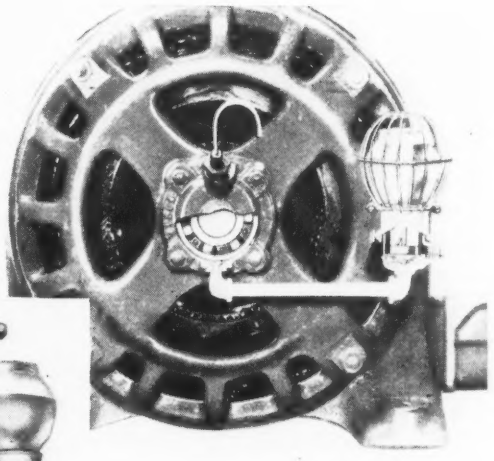
Nonadjustable Type

The design, Fig. 2, is not adjustable, but the fitting supporting the reservoir is hinged so that the bottle may be turned upside down for filling without removing it from its mounting. A self-closing spring hinge normally keeps the reservoir vertical. Oil level is controlled by sealing the top edge of the bevel on the shank, as in Fig. 1. When the motor is idle, the oil level is at about the top of the shading in the figure. When running, oil level just seals the bevel on the reservoir shank. These oilers are also made in a bayonet design with the shank held in a socket. To fill the reservoir it is pulled from the socket and turned upside down. After filling, it is returned to normal position.

In the design of Fig. 3, two pipes lead into the reservoir. Oil flows down the longer one as air is admitted up the shorter one. Oil level is maintained at a position determined by that which will seal the bevel on the shorter pipe. The bottle and cap lock onto the top of the tee fitting by a quarter turn of the former. Refilling of the oiler is done by removing the reservoir and its cap. The two are separated, the reservoir filled, its cap replaced, and the assembly returned to normal position.

Other designs of constant-level lubricators have been developed and are in use, but those described represent the general principles incorporated in the various types. One of the advantages of these lubricators is that they, to a large degree, eliminate the human element. They automatically supply oil to the bearings when the machine is running as long as there is oil in the reservoir, and stop oil flow to the bearing when the machine is shut down. The amount of oil in the reservoir can be easily seen from a distance, so that in difficult places it is not necessary actually to go to the bearings. As long as there is oil showing in the glass reservoir, there is no danger of dry bearings.





Figs. 7 (Top left) and 8 (right) —Automatic oilers, left with disk valve, right with ball valve

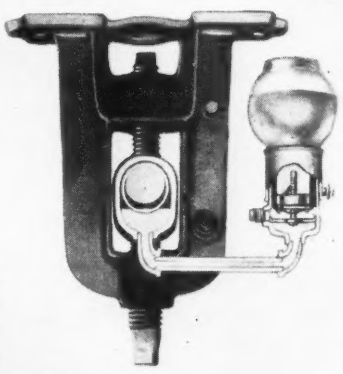


Fig. 4 (Below)—Constant-level oiler on ring-oiled motor

Fig. 5 (Right)—Constant-level lubricator on ring-oiled line-shaft bearing

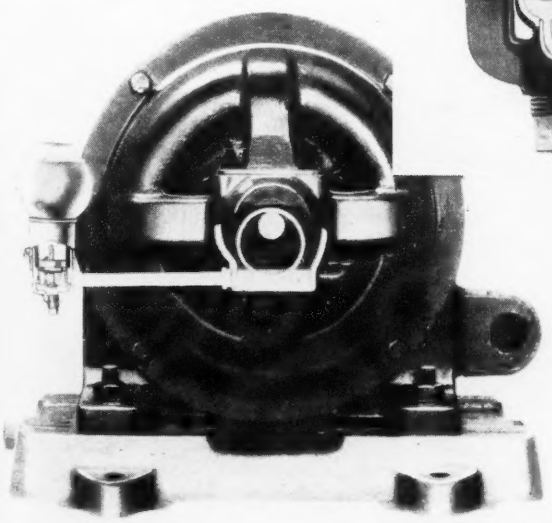
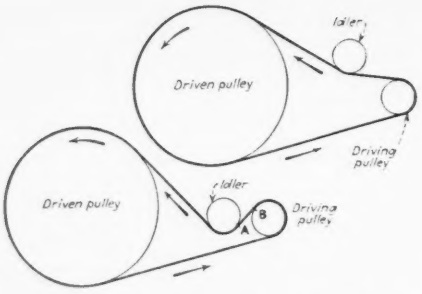


Fig. 6 (Above)—Constant-level oiler on motor with anti-friction bearings

Information for this article was supplied by Trico Fuse Manufacturing Co.; Industrial General Lubricating Co.; The Lunkenheimer Co.; Gits Bros. Manufacturing Co.; Speedway Manufacturing Co.; National Industrial Products Co.



Figs. 1 and 2—Wrong (top) and right (below) locations of idlers on belts

FLAT BELTS ON SHORT CENTERS

How to apply them and how to get long service from the applications

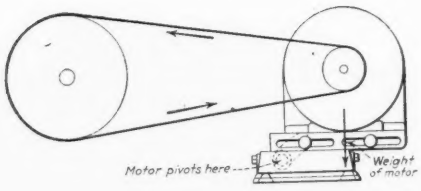


Fig. 3—Motor mounted on pivoted base to maintain uniform tension in slack side of belt

SPACE limitations are frequently a factor in flat-belt drives, making necessary operation with a short distance between driving- and driven-shaft centers. To meet these conditions several alternatives have been developed, such as idler pulleys, specially designed belts that have a high coefficient of friction and motors mounted on specially designed bases to maintain constant tension automatically in the slack-side of the belt.

When belts are used on short centers, their arc of contact with the small pulley is reduced, compared with that for long-center drives having the same pulley ratio. This requires operating an ordinary open drive with increased belt tension. As the belt is shorter and less elasitc, it does not allow the increased arc of contact obtained with a long-center drive with slack side on top. Even when pulleys have equal diameters, power-transmitting qualities of short-center belts are less than for long-center drives.

Of the devices developed to overcome these difficulties, the idler pulley is oldest. Chiefly because of misapplication, it has gotten the name of being hard on belts. Experience has shown, however, that when idler pulleys are of ample size and properly applied and maintained, long belt life is possible with them.

Not infrequently, idler pulleys are applied, Fig. 1, so that they are nothing better than a means of increasing belt tension. Such an idler operates to put maximum tension in the belt with very little increase in contact arc on the small pulley. When the idler is placed as in Fig. 2, it produces a large increase in arc of contact and permits the belt to be operated with minimum tension. As the load increases, the idler drops to a lower position, maintains the tension in the slack side of the belt and further increases its contact arc on the small pulley.

To obtain good belt life when using an idler pulley, it should be at least of a diameter equal to that of the small pulley. It should be so located that the straight section of belt between the two pulleys, distance *A-B*, Fig. 2, equals belt width. The idler pulley should have a flat surface, never crowned, and should be so mounted that its loading on the belt can be adjusted to the minimum necessary to drive the load. It should be flexibly mounted and supported in bearings of ample design to prevent binding so that the idler can freely follow the belt movement due to load changes.

None of these conditions are difficult to comply with in the average installation, yet it is surprising how few idler installations have been made that meet all of them. Two very common mistakes are: idler pulley too small, and straight section of belt between the two pulleys too short. The idler puts a reverse bend in the belt, which naturally subjects it to increased flexing. It also works the belt, due to its bending over the crown of the pulley and flattening out as it passes under the idler. In spite of this increased bending, large drives with idlers have given 10 to 15 years belt life. The answer to this is simply proper design, installation and operation of both belt and idler.

An idler on a flat belt has the advantages of maintaining practically constant tension in the slack side of the belt. The only change in tension is slight due to a changed position of the idler as the load changes. Where it is necessary to transmit power with a belt of given dimensions, a properly designed idler will permit greater loading than any other means. This sometimes becomes necessary where belt width and pulley sizes must be held to very definite limits. The idler permits just as satisfactory a drive with large pulley ratios as with small. For example, the drive, Fig. 5, has pulley diameters of 100 and 16 in., 84-in. centers, and transmits 175 hp.

On vertical drives any elongation of the belt due to load or stretch allows the belt to drop away from the lower pulley, causing a corresponding decrease in its power-transmitting capacity. Because of this condition 1% should be deducted from a belt's rated capacity for each degree it makes with the horizontal above 40 deg. Conventional open-belt drives operating in a vertical position should not be required to transmit more than 50% of their rated load for horizontal applications.

When a properly designed and installed flexible idler is used on a vertical belt drive it can be operated at its horizontal rating, proper allowance being made for load characteristics. No allowance need be made for belt elongation, since this is automatically compensated for by the idler.

Motors mounted on a pivoted base which maintains uniform tension in the belt have come into wide use during recent years. With this drive, part of the weight of the motors is balanced against the tension in the two strands of the belt. These bases have been developed for operating the motor in almost any position. The position of the motor with respect to the pivot points can be adjusted through a considerable range. This permits the motor to be positioned to operate the belt with minimum tension to drive the load, and with least wear and tear on the belt.

These bases are low in cost and suitable for mounting almost any design of motor, even the older types. They allow operating on very short centers. On certain classes of drives where pulley ratios are small, these drives operate on centers so close that there is only small clearance between the pulleys. For example, 7.5-hp., 1,750-r.p.m. motors, drive spinning frames with only 10 in. between pulley centers.

These drives are also suited for large pulley ratios and center-distance comparable to or shorter than with an idler application. An example is a 15-hp., 1,160-r.p.m. motor driving a paper calender through a belt on pulley centers of 32 in. and a speed reduction of 8 to 1.

When possible the motor should be placed so that the belt tight side comes between the pulley and the pivot point in the base. Fig. 3 shows this arrangement for a horizontal drive, but the rule holds for the motor in any position. Where this rule cannot be complied with, other arrangements are possible and can be used.

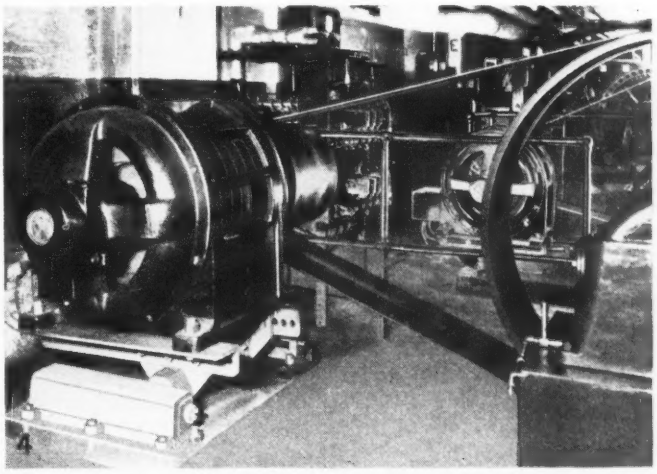
Differences Between Types

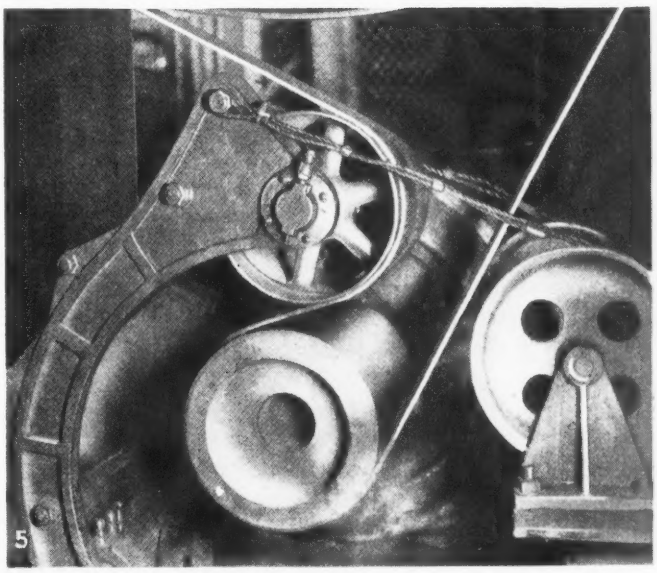
The pivoted-base motor and flexible-idler drives differ in two features: One, the pivoted-base motor maintains constant tension in the slack side of the belt without putting a reverse bend in it as does an idler. Two, the pivoted-base motor drive acts as a safety clutch where the flexible idler will not. When installed on a drive with the tight strand of the belt in the preferred position for the former, belt tension may be adjusted to carry any desired load within reason. When peak loads occur that exceed that value the belt will function as a clutch and slip to protect the motor.

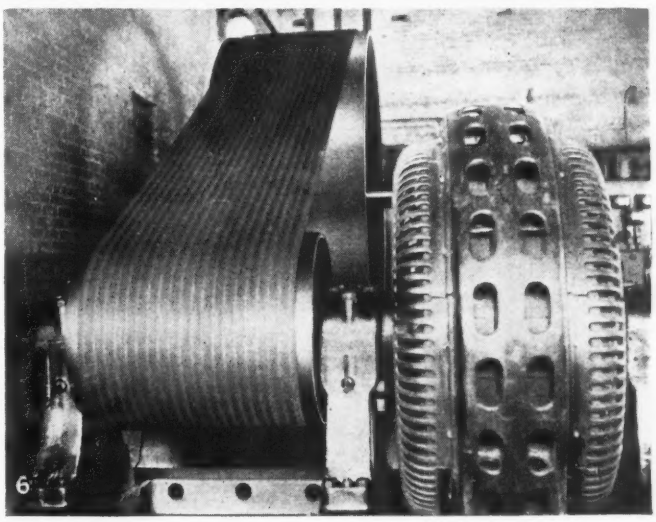
With an idler drive properly designed and installed, there is no definite clutch point beyond which the belt will slip and limit the load, particularly if non-metallic pulleys are used. As load increases, the natural slip of the belt increases slightly but it will continue to carry the load until the motor stalls. This is one of the reasons why some idler drives show a short life. A belt too small for the job because of the idler continues to operate without a protest even when it is grossly overloaded.

Several types of belts specially designed to operate on short-center drives have been developed. Their high coefficient of friction is obtained by special tannage or by a mechanical treatment of the inner surface of the belt, or by a combination. Operation even of these belts on short-center drives will be improved, their range of applications extended and life increased by use of automatic-tension bases on the motors.

Fig. 4—A 125-hp. and 75-hp. motor mounted on pivot bases driving air compressors by belts, shaft centers 72 and 84 in. respectively. Fig. 5—Flexible-idler drive transmits 175 hp., pulleys 16- and 100-in. diameter on 84 in. centers. Fig. 6—A 400-hp. motor drives fan by special belt, pulleys 30- and 96-in. diameters on 130-in. centers







HOW MUCH CONDITIONED AIR?

By A. Warren Canney

Clyde R. Place, Consulting Engineer

This seventh in a series of articles on air conditioning tells how to find the quantity of air required for conditioning, the temperature of the entering air supply, and the dewpoint leaving the conditioner

SUMMER conditioning depends upon the supply air to remove both heat and water vapor from the conditioned space. How much air must be supplied to do this job? This must be determined for worst summer conditions before fans, air washers or coolers, and ducts can be specified.

Quantity of air supplied to the room depends upon the sensible heat it must absorb and the permissible temperature rise. In any given conditioning problem, the heat load is fixed by building construction and use, and can not be altered by the kind or design of the conditioning system. Hence the temperature rise, which is determined by the permissible air inlet temperature, is the only variable in finding air volume supplied, and may be calculated for practical use from the formula:

$$c.f.m. = \frac{56 \times (B.t.u.\ sensible\ heat\ per\ minute)}{(room\ temperature - entering\ air\ temperature)}$$

To avoid uncomfortable drafts the entering temperature should not be greatly below room temperature, but to remove the heat this would obviously require that a very large volume of air be supplied. From the viewpoint of operating economy and low first cost, the volume of air supplied should be as low as possible; consequently these two opposing factors must be balanced.

Air might be delivered at the dewpoint necessary to produce the required relative humidity in the room. It would require the lowest possible air volume but would be uncomfortable and is never done. Consequently, reheating, bypassing or using a non-saturating coil must be resorted to.

A Good Rule

A good rule applicable to most cases when cooling is to allow $\frac{3}{4}$ deg. rise in temperature for each foot of headroom. This applies to non-aspirating outlets discharging horizontally close to the ceiling which covers 90% of the applications. Thus in a 14-ft. high room in which a temperature of 78 deg. is desired at maximum load, the entering temperature with a non-aspirating outlet would be 78 — 10.5 = 67.5 deg.

If the room is small and other conditions combine to indicate a low-velocity supply and therefore a non-aspirating outlet, and if it is required to absorb 1,000 B.t.u. of sensible heat per min. at maximum load, the volume of air supply required will be

$$\frac{1{,}000 \times 56}{78 - 67.5} = 5{,}340 \text{ c.f.m.}$$

The supply fan must be capable of delivering this volume and is usually specified for 10 to 20% greater capacity.

If a high discharge velocity, say 950 ft. per min., is permissible and the manufacturer's catalogue shows an aspirating grille that at this velocity will aspirate an equal volume of room air, then the air supply can be 21 deg. below room temperature, as the mixture of equal volumes could still provide a 10.5-deg. difference a few feet from the outlet. In this case the volume of supply air becomes

$$\frac{1{,}000 \times 56}{21} = 2{,}670 \text{ c.f.m.}$$

When reheating is accomplished by allowing some of the recirculated air to by-pass the air washer, it becomes desirable to determine the quantity of air that has to flow through the washer at maximum load. To do this it is first necessary to find the dew point or saturation temperature to which the washer must cool. This can be obtained from the equation:

$$\frac{H_L}{H_T} = 1 - 0.241\ \frac{(T_R - T_d)}{(h_r - h_c)}$$ where

H_T and H_L are respectively the total heat and the latent heat that has to be removed from the room per minute at maximum load, T_R is room dry-bulb temperature, T_d is dewpoint temperature leaving conditioner, and h_R and h_c are respectively the heat per lb. of dry air in the room and leaving the conditioner as given by psychometric charts. In this equation, both T_d and h_c are unknown, but the equation can be solved by cut-and-try methods, as any assumed T_d fixes the value of h_c as the air is saturated. To avoid this trial-and-error process, a chart has been prepared from which the dewpoint temperature can be found.

It is interesting to note that dewpoint temperature does not depend upon the quantity of air through the washer, and is influenced only by the ratio of latent to total heat and the temperature and relative humidity to be maintained in the room.

To use the chart to find the dewpoint temperature proceed as follows:

1. Calculate the maximum sensible heat H_s to be absorbed by the supply air. This should include heat absorbed by the supply air as it passes through the ducts.

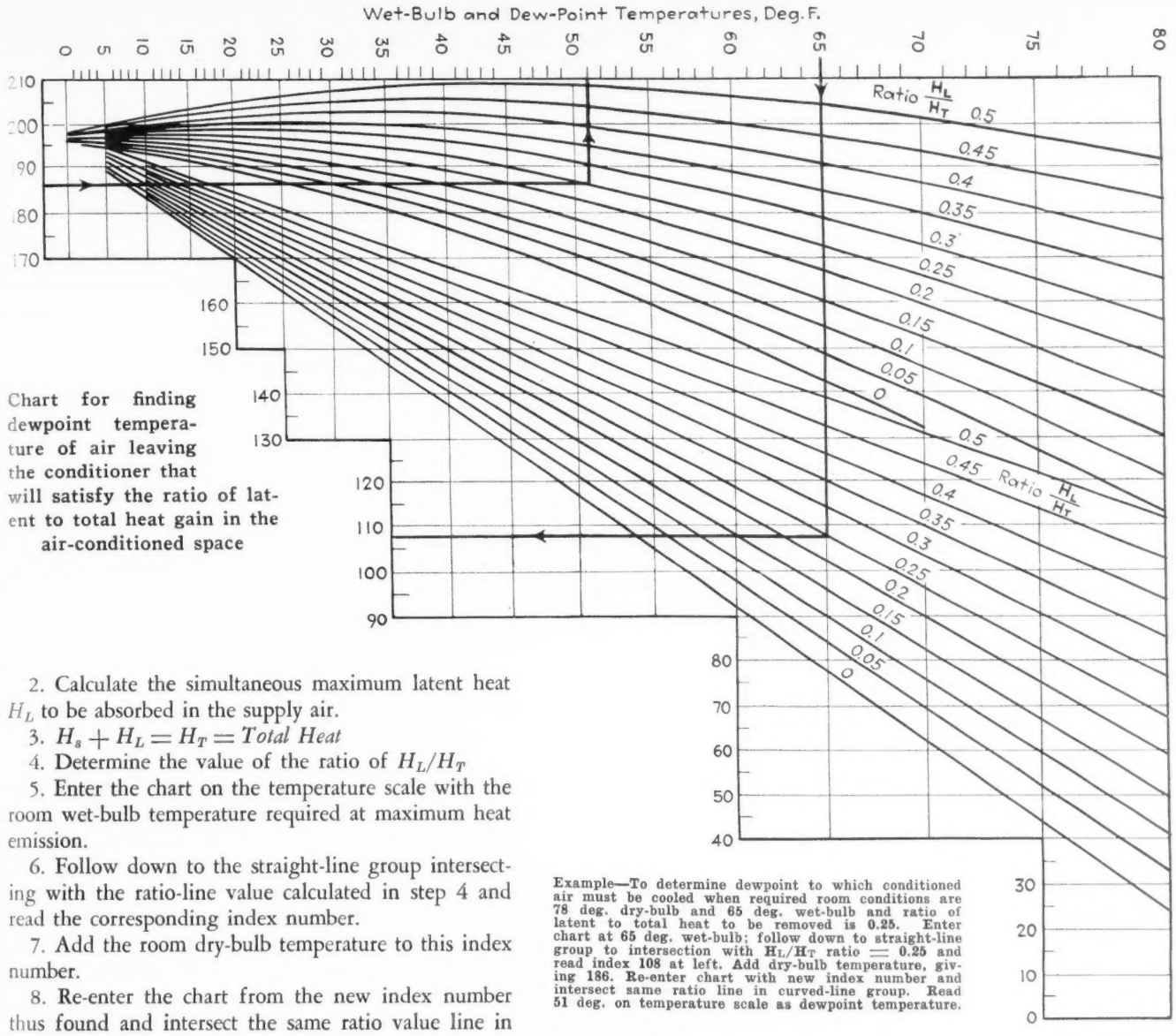


Chart for finding dewpoint temperature of air leaving the conditioner that will satisfy the ratio of latent to total heat gain in the air-conditioned space

Example—To determine dewpoint to which conditioned air must be cooled when required room conditions are 78 deg. dry-bulb and 65 deg. wet-bulb and ratio of latent to total heat to be removed is 0.25. Enter chart at 65 deg. wet-bulb; follow down to straight-line group to intersection with H_L/H_T ratio = 0.25 and read index 108 at left. Add dry-bulb temperature, giving 186. Re-enter chart with new index number and intersect same ratio line in curved-line group. Read 51 deg. on temperature scale as dewpoint temperature.

2. Calculate the simultaneous maximum latent heat H_L to be absorbed in the supply air.

3. $H_s + H_L = H_T = Total\ Heat$

4. Determine the value of the ratio of H_L/H_T

5. Enter the chart on the temperature scale with the room wet-bulb temperature required at maximum heat emission.

6. Follow down to the straight-line group intersecting with the ratio-line value calculated in step 4 and read the corresponding index number.

7. Add the room dry-bulb temperature to this index number.

8. Re-enter the chart from the new index number thus found and intersect the same ratio value line in the curved-line group.

9. Read the corresponding value intersected on the temperature scale. This will be the required dewpoint temperature to satisfy the proportions of latent and sensible heats to be absorbed with a saturated supply or from any conditioner which saturates when cooling.

An Example

For example, assume a room, which has a maximum total heat gain of 1,333 B.t.u. per min., of which 333 B.t.u. is latent heat and 1,000 is sensible heat, is to be maintained at 78 deg. and 50% relative humidity. The corresponding wet-bulb temperature is 65 deg. and the dewpoint temperature 58 deg. The heat load gives a value of H_L/H_T of 0.25, and the chart shows an air washer should saturate the air to a dewpoint of 51 deg. and the volume of air through it should be

$$\frac{1{,}000 \times 56}{78 - 51} = 2{,}080 \text{ c.f.m.}$$

It will be remembered it was calculated that 5,340 c.f.m. of supply air was necessary if the entering temperature was 67.5 deg. Thus the amount of air by-passing the washer would be 5,340 — 2,080 = 3,260 c.f.m. A check will show that mixing 3,260 c.f.m. of return air at 78 deg. and 50% relative humidity with 2,080 c.f.m. of saturated air at 51 deg. dewpoint will give a final dry bulb of 67.5 deg. If the aspirating grilles are used, the air by-passing the washer becomes 2,670 — 2,080 = 590 c.f.m.

With air conditioners having metal cooling coils designed for direct expansion of refrigerant or for chilled water, the problem is more complicated as in most cases the air leaving them is not saturated.

On a Straight Line

It will be found if a straight line is drawn between the dewpoint found from the chart and the room air conditions on a psychometric chart having substantially straight dry-bulb, dewpoint and wet-bulb temperature lines that the air entering the room will be on this line.

In many instances engineers fix air volume after they have selected the air washer or cooling coils. This is not good practice and is conducive to unsatisfactory air conditioning. Air volume and distribution should be considered and decided upon before equipment is selected.

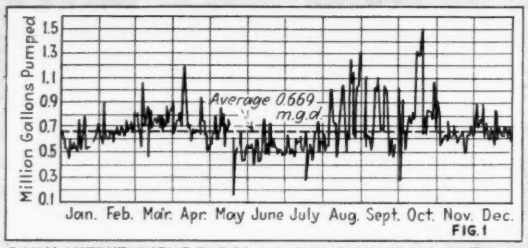


FIG. 1

DAILY OUTPUT CURVE FOR MUNICIPAL PUMPING PLANT

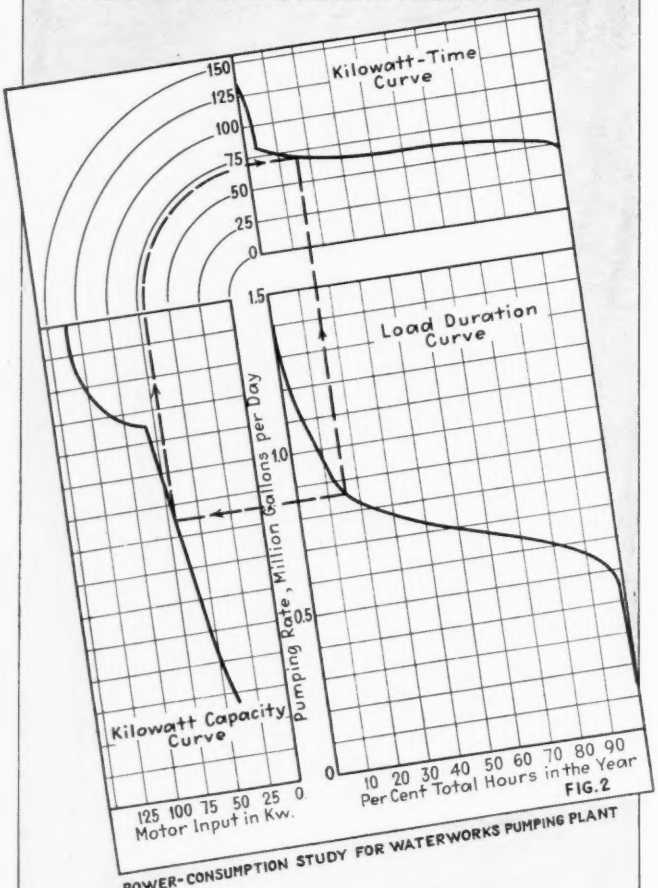


FIG. 2

POWER-CONSUMPTION STUDY FOR WATERWORKS PUMPING PLANT

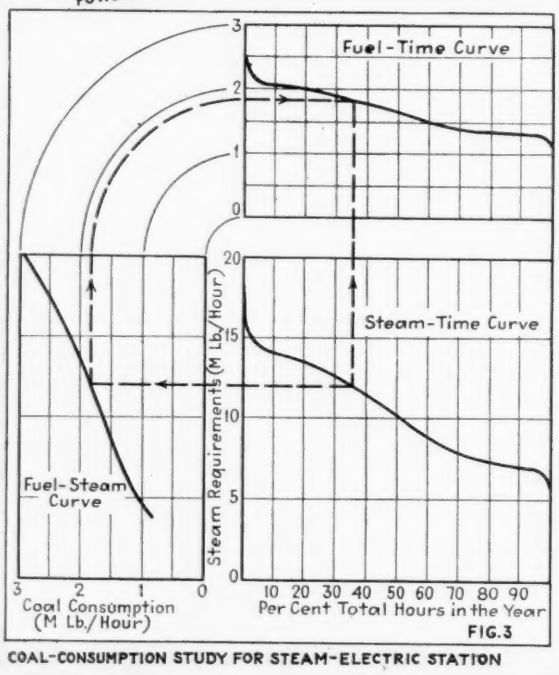


FIG. 3

COAL-CONSUMPTION STUDY FOR STEAM-ELECTRIC STATION

VARIABLE-LOAD

By Glenn C. Boyer

Burns & McDonnell Engineering Co.

ENGINEERING is not a matter of selecting machines for a given application, but rather choosing equipment that will do the work at the *lowest total annual* cost. This includes a study of power required. It is easy to determine power input to a pump for any particular output, but difficult to calculate total yearly power consumption for a variable load, such as that in Fig. 1. The average daily pumpage in the figure is 660,000 gal., with a maximum of 1,490,000 and a minimum of 150,000 gal. per day.

I have developed a quick and accurate method of determining total energy input during any period of variable output. In this discussion of the method, its applications to water-pumping plants and to selecting units for small electrical generating stations are considered.

Pumping Units

Fig. 1 shows the variation in quantity of water pumped daily to supply a community of about 5,000 people. These pumps are required to operate against a total head of 400 ft. Since hourly variations in pumping rate were not available, it has been assumed that the water supplied during any day would be at the average rate for that day, sufficient water storage being available to care for hourly variations. This assumption is not strictly true in this case, but is sufficiently accurate for the purpose. It was proposed to use two single-stage, 750-g.p.m., 3,550-r.p.m. centrifugal pumps, each directly connected to a 100-hp. induction motor.

To determine the annual power consumption taken by the pump motors, it is first necessary to develop a load-duration curve from the daily water pumping record, Fig. 1. For this curve the abscissas are percentage operated of the total hours in the year and the ordinates are pumping rates in millions of gallons per day. A good description of how this curve is developed will be found in the article "The Load Duration Curve," by A. G. Christie, professor of mechanical engineering, Johns Hopkins University, *Power,* Feb. 16, 1932, pages 243-245.

In Fig. 2 the lower right-hand curve is the load-duration curve derived from the daily pumping record, Fig. 1. Each point on the curve indicates the percentage of hours during the year when the pumping rate was equal to or exceeded the value of the ordinate at that point. The curve was evolved by grouping all pumping rates of a given value. These values were

ANALYZING

Quick, accurate and simple, Mr. Boyer's new method is readily applicable in choosing most economic equipment

plotted as ordinates with per cent total time as abscissa, beginning with the largest value found on the daily output curve, Fig. 1.

Theoretically the area under this curve is directly proportional to total gallons pumped. If care is taken to obtain a sufficient number of points, the area under the curve will vary less than 5% from actual pumpage. In this case the variation is about 9%, due largely to data missing in Fig. 1.

With a load-duration curve for the pumping plant, the next step is to develop an input-output curve, or kilowatt-capacity curve, for the pumping units. This curve was developed for the two motor-driven pumps previously mentioned and is obtainable by plotting pumping date values on the load-duration curve against kilowatt inputs to the pump motors corresponding to these pumping rates. A definite break occurs in the kilowatt-capacity curve at approximately 1,150,000 g.p.d. due to putting two pumps into service at this point, each at reduced capacity. Zero abscissa for this curve is on the right and progressively larger values are plotted to the left, which is the reverse of increasing abscissas for the load-duration curve.

From these two curves can be developed a kilowatt-time curve, shown in the upper right-hand corner of Fig. 2. This curve is developed by taking points on the load-duration curve and projecting them vertically upward until they intersect corresponding points on the input curves that have been projected both vertically and horizontally. For example, take the point 850,000 gal. on the load-duration curves. Project from this point directly upward onto the kilowatt-time curve plot. Also project point 850,000 gal. on the load-duration curve horizontally to intersect the kilowatt-capacity curve at 69 kw. Project this point upward to the top of the plot and rotate it 90 deg. onto the kilowatt-time curve. Then, project horizontally from the left-hand edge of the kilowatt-time curve until intersecting the vertical projection from the load-duration curve. The intersection is one point on the kilowatt-time curve. This operation can be traced readily by following the dotted lines and arrows. Other points are obtained similarly on the kilowatt-time curve until the curve can be completed.

The area under this kilowatt-time curve is proportional to total kilowatt-hours necessary to pump the water represented by the area under the load-duration curve. In this particular instance it was found that 577,000 kw.-hr. were required to pump 266,500,000

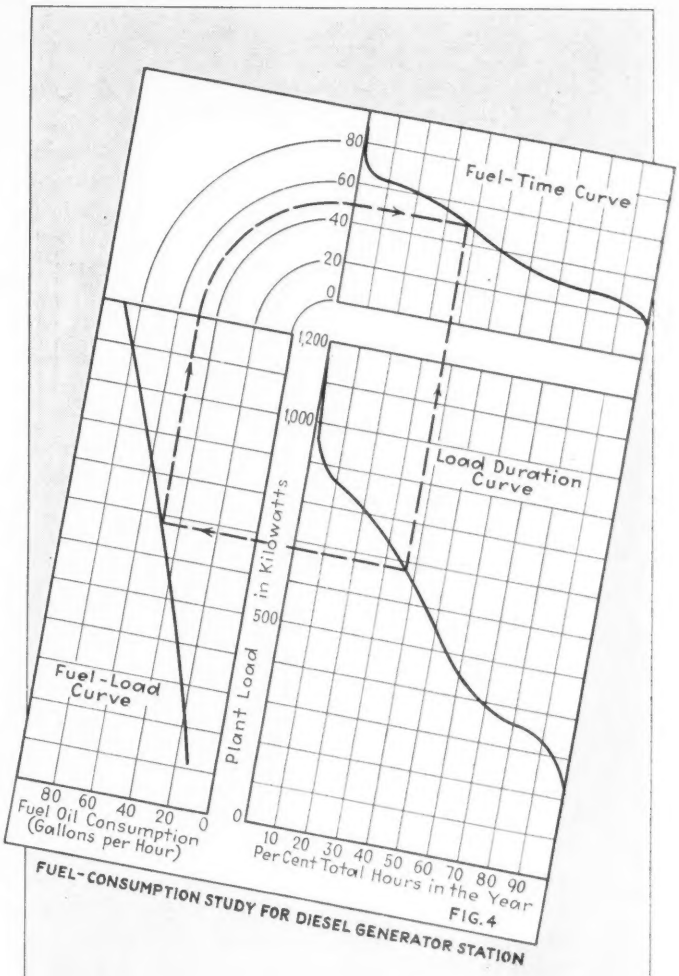


FIG. 4 FUEL-CONSUMPTION STUDY FOR DIESEL GENERATOR STATION

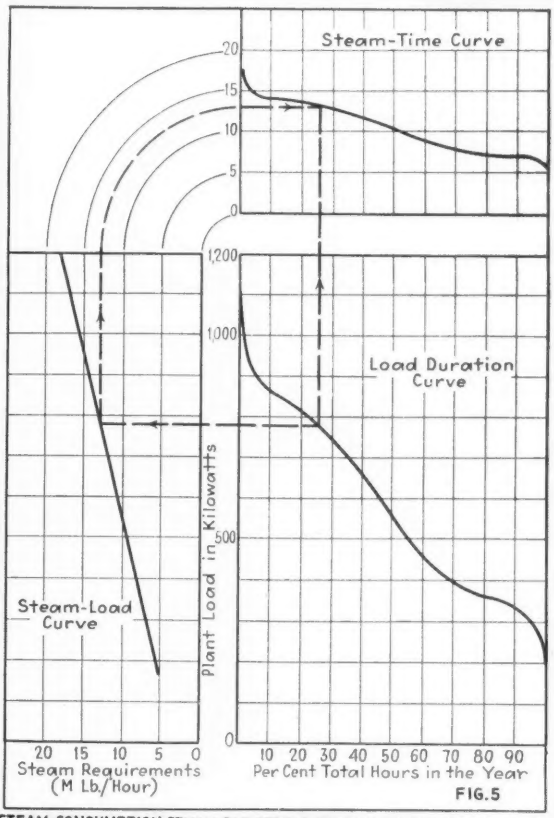


FIG. 5 STEAM-CONSUMPTION STUDY FOR STEAM-TURBINE-GENERATOR PLANT

gal. during the year on an average of 2.18 kw.-hr. per 1,000 gal. against a 400-ft. head.

Any other combination of motor-driven pump sizes for this plant could be analyzed in the same manner. It would be in the interest of economy to develop kilowatt-capacity curves for several pump combinations in order to select that best suited to the application. From these kilowatt-capacity curves, one or two combinations of units could be selected that showed the lowest power input at all loads. Kilowatt-time curves could then be developed for groups of units selected. Savings in power costs could be balanced against increased fixed charges due to purchasing more efficient units, and the combination showing the best over-all economy selected.

This graphic method for totalizing variable-load information can be applied to determining total input and output for any load where either output or input can be converted into a load-duration curve. As an example, take a study of small power-generating stations using both diesel engines and steam turbines for prime movers.

Diesel Engines

Consider a plant using diesel engines as prime movers. The load-duration curve for this plant is shown in the lower right-hand corner, Fig. 4. The maximum load is 1,200, the minimum 200 kw. Two 700-kw. generators connected to 1,000-hp. engines can handle the peak loads and provide some reserve capacity. Standby capacity is not considered. From guaranteed fuel-consumption data for the two units, and with an operating schedule for them, a fuel-oil-consumption curve for various station loads can be developed. This fuel-load curve, Fig. 4, is plotted from kilowatt loads as ordinates and gallons of fuel oil per hour as abscissas.

From these two curves a fuel-time curve is developed in which per cent total time are abscissas and gallons of fuel oil consumed per hour are ordinates. This curve is obtained similarly to the kilowatt-time curve, Fig. 2. The fuel-time curve shows a maximum oil-consumption rate of 88 gal. per hr. and a minimum rate of 18 gal.

The area under the fuel-time curve is proportional to total fuel oil required to generate the power represented by the area under the load-duration curve. In this particular instance it was found that 373,877 gal. of 20 deg. Bé. fuel oil were required to generate 4,865,600 kw.-hr., an average of 13 kw.-hr. per gallon. Any other combination of diesel-driven generating-unit sizes for this plant could be similarly analyzed to obtain the most economical combination.

The area under the load-duration curve, Fig. 4, is proportional to the total kilowatt-hours generated. Since abscissas represent per cent total hours in the year and ordinates represent hourly plant load in kilowatts, any unit area, such as a square inch, represents a definite number of kilowatt-hours. Assuming that 1 in. horizontally represent 25% of the total time, or 2,190 hr., and that 1 in. vertically equals 200 kw., then 1 sq.in. of area represents 2,190x200 = 438,000 kw.-hr. With a planimeter, the area under the curve can be determined in square inches, and the total kilowatt-hours generated is then the product of the area in square inches and the conversion factor of 438,000 kw.-hr. per sq.in.

A similar conversion can be made for the fuel-time curve by finding the total gallons of fuel oil represented by a unit area under the curve, determining the total area under the curve, and converting this area into total gallons of fuel oil.

Steam Turbine

The lower right-hand curve, Fig. 5, is the load-duration curve. For this study a 1,500-kw. turbine-generator is used, operating at 300 lb. pressure, 600 deg. F. total steam temperature, and exhausting at 27½ in. vacuum. Standby capacity has not been considered. Heat-balance calculations for several load points gave the steam-load curve of steam requirements for various kilowatt loads.

The steam-time curve is developed similarly to the kilowatt-time curve in Fig. 2. The area under the steam-time curve is proportional to the total quantity of steam required for the year's operation.

To complete the steam-generating plant study, Fig. 3 was developed by using the steam-time curve, Fig. 5, together with boiler and coal-consumption data. The fuel-steam curve was plotted as the relation of boiler steam output to coal input. This curve was developed for a single boiler having 5,280 sq.ft. of heating surface exclusive of the superheater and supplying steam at 350 lb. gage and 635 deg. total temperature, with coal having 11,050 B.t.u. per lb. From these two curves the fuel-time curve can be developed. The area under this curve is proportional to the total coal consumed to generate the kilowatt-hours represented by the area under the load-duration curve, Fig. 5.

The steam-load curve, Fig. 5, and the fuel-steam curve, Fig. 3, can be combined, and a resulting curve developed with plant load in kilowatts as ordinates and coal consumption in 1000 lb. per hr. as abscissas. This fuel-load curve would enable the plotting of a fuel-time curve without the necessity of first developing a steam-time curve. Some power plant designers prefer to have information on steam as well as fuel consumption, both of which were developed in Figs. 3 and 5.

From these two figures it was found that in order to generate 4,865,600 kw.-hr. (as represented by the area under the load-duration curves, Fig. 5), the boiler would have to produce 92,505,600 lb. of steam and burn 14,436,500 lb. of coal with a heat content of 11,050 B.t.u. per lb. as fired. This means a coal requirement of 2.97 lb., or 32,785 B.t.u. per kw.-hr. generated. Actual operation of steam equipment under the conditions, Fig. 3 and 5, showed coal requirement of 3.21 lb. or 35,470 B.t.u. per kw.-hr. output. While there is a difference of 7.5% between actual operation and theoretical studies on this particular combination, all of it is not due to inaccuracies in the theoretical study. Part is accounted for by the combustible material in the ash, and part by efficiency of the plant being decreased by using available low-pressure boilers and generating units for a part of the year.

MANY POWER PAPERS
in Cincinnati A.S.M.E. Program

Semi-annual meeting features big hydro turbines, steam turbine design and operation, piping, bearings and lubrication, boilers, furnaces and firing, Velox boiler

MANY papers of interest to *Power* readers were presented at the semi-annual meeting of the American Society of Mechanical Engineers, Hotel Gibson, Cincinnati, Ohio, June 18-21. Regular sessions were confined to Wednesday, Thursday and Friday, Tuesday being reserved for Council meeting and Saturday for a trip to T.V.A. (Knoxville) and Norris Dam. In addition there were luncheons, dinners, social events and numerous visits to the industrial plants for which Cincinnati is famous.

Subjects of papers included: hydraulic turbines, loading of steam turbines, leakage of steam through labyrinth seals, leaving losses and vacuum corrections, industrial lubrication, bearing friction, automatic control, pipe stresses, boiler tubes, the Velox boiler, furnace radiation, pulverized-coal firing, slag-tap furnaces.

Boulder Dam

In the hydraulic session Wednesday morning, W. M. White, manager and chief engineer, Hydraulic Department, Allis Chalmers Mfg. Co., discussed the design, construction and testing of the high-head 115,000-hp. turbines for Boulder Dam, R. V. Terry and G. C. Moorhead, Newport News Shipbuilding & Drydock Co., described the nine Dnieprostroy turbines in Russia, and design of the world's most powerful fixed-blade, propeller-type turbine, for Wheeler Dam, was discussed by F. H. Rogers and R. E. B. Sharp, Baldwin-Southwark Corp.

Power generation, Dr. White reminded his hearers, was only incidental in the erection of Boulder Dam. Primary considerations were regulation of the Colorado river to prevent floods and water storage for irrigation and city-water supply. These three will control storage-reservoir levels, and the turbines must therefore operate under heads varying between 420 and 590 ft.

The Colorado River carries 137,000 acre-feet of silt yearly. In ten or fifteen years the washing out of silting below the dam may lower the tailwater level 25 ft. The turbines therefore are set 10 and 29 ft., respectively, below the expected tailwater normal and maximum levels.

Turbine size selected was the largest that could be economically constructed and transported. Because of high head and stresses, runners were cast in one piece. These considerations led to the selection of fifteen 115,000-hp. units and two 55,000-hp. units (capacities based on 476-ft. head). While the large generators can absorb only 115,000 hp., their turbines could develop 158,000 hp. at 590-ft. head. Speed is 180 r.p.m.

Water columns are of considerable length, requiring a design of ample strength to resist water hammer. Each turbine has a pressure regulator with a discharge capacity 80% of that of the turbine. The spiral casing is 50 ft. across and 10 ft. in diameter at the intake. Its six sections, cast with flanges for bolting together, have a combined weight of 450,000 lb.

Specifications required the sections to be shop tested at 500-lb. water pressure and corresponding measurements of stresses by strain gages. Elaborate research was conducted on bolt materials and flange design. Testing machines determined the stress-strain relations of the S.A.E. 3540 bolt material. Complicated and questionable flange formulas were replaced by the results of actual deformation measurements on flanged cast-steel pots bolted together. Separation of the interior edges of the flanges was ingeniously measured by electrical contact-type micrometers welded inside and manipulated through stuffing boxes. These tests showed that metal added to wall thickness is eight times as effective as metal added to flange diameter.

The unit design incorporates 24 cast-steel guide vanes with integral stems, cast-steel levers with breaking pins, cast-steel shifting ring, cast-steel cover plate in halves, cast-iron babbitted oil-lubricated bearing.

The 39-in. shaft is made in two sections, and a crane is placed beneath the generator so that the turbine may be dismantled without disturbing the generator. To reduce the high percentage of leakage characteristic of low-specific-speed units, sets of wearing rings are provided on both top and bottom of the runners. Stationary rings are of stainless steel, runner rings of SAE 1035. Arrangements are made to grind the rings truly on the job after erection. The draft tube is of cast-steel sections in the upper part and welded plate below.

Discussing Dr. White's paper, F. H. Rogers praised the experimental work done on flanges and said this was the only practical way to achieve a sound design.

Dnieprostroy Project

The nine Dnieprostroy turbines described by Messrs. Moorhead and Terry were manufactured in the United States for the U.S.S.R. The Dnieprostroy hydro-electric and navigation development formed a part of the Soviet government's first 5-year plan. It is located in Southwestern Russia on the Dnieper River about 200 mi. from the Black Sea. Construction was started in 1927, and the first generating unit placed into operation in May, 1932.

This is the largest hydro-electric plant in operation and includes a concrete dam 5,000 ft. long by 140 ft. high with a spillway 2,005 ft. long. The maximum recorded flood is 835,000 sec.-ft. A maximum gross head of 123 ft. and a normal gross head of 116.5 ft. obtain. Each turbine, when operating under the former head, will develop 100,000 hp. and, under the latter head, 84,000 hp. at a speed of 72.2 r.p.m. It is estimated that the ultimate annual power output of the plant will be 2.5 billion kw.-hr.

Five of the generators, each rated 77,500 kva., and the nine governors, were also built in the United States. The other four main generators are being built in Russia. All nine turbines are now installed and six units have been placed in operation. The other three machines will be started as the generators are completed and as load increases. Four units are now operated to develop about 200,000 kw. for two systems. The power is used in steel furnaces and for smelting aluminum silicate, for other metallurgical work and general industrial applications. Load is building up rapidly, and it is expected that the regulated river flow will be utilized in the near future.

Much of the discussion centered on the value of air admitted just above the draft tube to reduce vibration. Logan S. Kerr said such admission is frequently helpful and sometimes necessary. The meeting chairman, C. F. Merriam, told of a case (Safe Harbor Plant) where such air admission permitted overload capacity through limitation of vibration.

Serving now chiefly for river control, the Wheeler Dam plant will, for the present, install only one of the 8 projected propeller-

A.S.M.E. Nominees

President

W. L. BATT
President, SKF Industries, Inc.

Vice-presidents

A. D. BAILEY
Supt., Gen. Stations, Commonwealth Edison Co.

J. A. HUNTER
Prof., Univ. of Colo.

R. L. SACKETT
Dean, Pa. State College

W. A. SHOUDY
Consulting Engineer

Managers

W. L. DUDLEY
Vice-pres., Western Blower Co.

W. C. LINDEMANN
Sec., A. J. Lindemann & Hoverson Co.

J. W. PARKER
Chief Engineer, Detroit Edison Co.

type units. This will be of the fixed-blade type, because head is practically constant and ample water for the one unit is always available. Some of the later units may be of the Kaplan type. As pointed out in the paper by F. H. Rogers and R. E. B. Sharp, this first 45,000-hp. unit is the world's most powerful fixed-blade propeller-type wheel, with the largest dimensions of any such in the United States. Diameter is 22 ft., maximum discharge about 9,150 c.f.s.

The contract specified that test data of a scale model ($\frac{1}{4}$ scale) expanded by formula to the full dimensions should be taken as the test performance of the actual unit. This procedure was agreeable to the I. P. Morris Co., which had found, in several cases, that it agreed within 1% with the test results on full-size units.

The runner, mounted 6 ft. below tailwater, can be removed (with the shaft) without disturbing the guide vanes. The authors stressed their preference for rubber-guide bearings because of simplicity, no cutting and no stuffing box. The Wheeler-Dam unit uses a bearing with longitudinal steel strips with vulcanized rubber facing.

Discussing the history of Wheeler Dam, Ross M. Riegel, T.V.A. hydraulic engineer, said that the tailwater range is only 7 ft. for a flow range from zero to maximum. Moreover, headwater level must be closely controlled (within 3 ft.) to limit mosquito breeding. This gave a practically fixed head of 48 ft. and favored the fixed-blade wheel. He said that the horizontal sections of all 8 draft tubes have been built now to avoid the future necessity of using a 50-ft. cofferdam. He expected the first unit will start operation in the fall of 1936.

In discussion, Dr. White questioned the superiority of rubber bearings for most installations, mentioning high cost for one item. He said Allis Chalmers is now using babbitted bearings without stuffing boxes, pumping moderate amounts of oil (about $300 worth yearly in a large turbine), which leaks to waste.

Technical Papers

"Division of Load among Generating Units for Medium Costs" (Published in April A.S.M.E. *Transactions*), by J. E. Mulligan, M.I.T., presents and analyzes various combinations of input-output curves of generating units and shows how to use them to divide the load economically among the various units. The paper has direct application value chiefly for operators of central stations and utility generating systems, although the principles involved apply universally.

"Leakage of Steam Through Labyrinth Seals" (April *Transactions*), by A. Egli, Westinghouse. Highly technical analysis of interest to steam turbine designers.

"Steam-Turbine Leaving Losses and Vacuum Corrections" (May *Transactions*), by Linn Helander, Kansas State College. While technical and highly detailed, this paper is designed for direct application by test engineers generally associated with large central stations.

"Loading and Friction of Thrust and Journal Bearings" (May *Transactions*) by H. A. S. Howarth, Kingsbury Machine Works. While technical in character, this paper is of direct practical value to bearing designers, because it brings together for the first time formulas and charts that have been offered by bearing analysts in this field for the past fifteen years.

"Application of the Elastic Point Theory to Piping Stress Calculations" (May *Transactions*), by S. W. Spielvogel, Brooklyn Edison Co., and S. Kameros, N. Y. Edison Co. Piping system designers whose "math" is in good working order will find here a method of analyzing pipe stresses somewhat less laborious than most of its predecessors.

"Principles underlying the Rational Solution of Automatic Control Problems" (May *Transactions*), by S. D. Mitereff. This analysis presents twelve fundamental equations, of which six (the author believes) cover all present forms of commercial regulators and six cover improvements of possible value. This paper will be of interest to designers of control equipment and systems.

For some years, F. F. Fisher and E. T. Cope, Detroit Edison Company, have been studying rolling-in boiler tubes. Mr. Fisher

Dr. Irving Langmuir
Presented with the Holly Medal

is general superintendent of mechanical erection and Mr. Cope a member of the research department. Their paper on this subject (published in May *Transactions*) contains much of practical interest and is believed to be the first extensive study published in English. Conclusions may be summarized as follows:

1. The rolling-in process may be broken down into two separate phases: expanding the tube until it fits the hole, and further expansion to tight contact. Each phase should be definitely controlled to produce a tight and strong joint.

2. Ordinarily these two phases are not controlled, so there is no uniformity of results. Over-rolling cold-works the tube and surrounding plate, setting up stress concentration with predisposition to corrosion fatigue.

3. In the "elongation" method of tube rolling, the two phases are definitely controlled by a dial indicator clamped to the tube. An elongation of 0.02 in. seems to produce the most satisfactory joint.

4. Further study is needed of the effects of surface finish, hardness, grooves in the tube hole. There also seems room for improvement in rolling tools.

The Calvin W. Rice Memorial Lecture was delivered by Adolphe Meyer, managing director of Brown Boveri Co., Baden, Switzerland. Presiding was Harvey N. Davis, who, as president of Stevens Institute of Technology, had presented Dr. Meyer with an honorary degree a few days before. Dr. Meyer, noted for his pioneer work with centrifugal compressors, large steam turbines, gas turbines and diesel supercharging, presented a paper on the Velox boiler, probably the most radical boiler development of this generation.

This unit, previously described in *Power*, is in fact a combination of steam generator, gas turbine and centrifugal compressor. The compressor supplies combustion air at a pressure of about 35 lb. gage. Gas velocities through the tubes often exceed that of sound, giving an over-all heat-transfer rate of 105,000 B.t.u. per sq.ft. per hr. per deg. F. Heat release in the pressure furnace is 840,000 B.t.u. per cu.ft. per hr. Water pumped through the bolier at high velocity is about ten times the steam production; a centrifugal separator is used to separate the steam. The gas turbine (driving the turbine compressor) is protected against excessive temperatures by placing it between the superheater and the economizer. The Velox boiler runs at about 3,000% nominal rating.

Chief advantages claimed are low cost, low weight, small space, extreme speed of starting up from cold (about 4 min. to full pressure and output). In the past three years, 24 units have been sold in Europe for land plants, ships, locomotives, etc. On ships, particularly, Dr. Meyer said, the saving in weight and space is enormous.

Furnace Radiation

In the Friday morning Fuels Session, a paper by H. O. Croft and C. F. Smarje, State University of Iowa, presented some new data on the radiation intensities in boiler furnaces and described a new type of fused-quartz window absorption calorimeter used in 28 boiler tests. They also studied the absorption of radiant heat by clean and dirty surfaces and compared the results with those computed from the Hudson-Orrok and Wohlenberg formulas. The complete paper appeared in April *Transactions*.

In the discussion Mr. Orrok said that several hundred boiler designs have shown that the Hudson-Orrok formula will predict operating conditions within 5%.

Slag-Tap Furnaces

"Slag Tapping of Flat-Bottom Boiler Furnaces," by J. H. Strassburger of Weirton Steel Co., was of exceptional practical interest. It described long and interesting experience with pulverized-coal-fired boilers at the Weirton, West Va., plant. The most recent design of furnace bottom, now operating satisfactorily, consists of one course of 9-in. firebrick laid on end and covered with 6 in. of plastic chrome.

Slag is tapped from each boiler (lowered from 18 in. to 6 in.) every 24 hr. The furnace is sloped toward the tapping hole. When tapping slag, the top bricks are removed first and lower bricks as the slag level falls. The operation has been a success over a wide range of boiler operating conditions. Furnace CO_2 is maintained at 14 to 15%. Heat liberation in the furnace ranges from 10,500 to 16,400 B.t.u. per cu.ft.

In a paper on the possibilities of pul-

verizers for small boilers, James W. Armour, vice-president and engineering manager, Riley Stoker Corporation, compared the pulverizer with the stoker for boilers between 1,000 and 5,000 sq.ft. and concluded that the pulverizer is preferable in many cases. Following is a brief summary of his analysis and conclusions: In large units, pulverized coal is becoming the predominant method of firing soft coal, but this has not been true of units under 5,000 sq.ft. (of boiler heating surface). Let us compare two units, one stoker-fired and one pulverized coal-fired. These are 1,500-sq.ft. h.r.t. boilers operated at a maximum rating of 150% at 125 lb. pressure, and 150 deg. feedwater temperature.

Setting heights are 9 ft. Because heat release is only 9,000 B.t.u. per cu.ft. per hr. with pulverized coal, solid brick walls are used in both cases. The stoker-fired units will be $302 cheaper in first cost. Assuming 70% over-all efficiency for the stoker and 75% for the pulverizer unit, and an average rating of about 75% over the entire year, and assuming also that the stoker is fired with a mixture of nut and slack coal, costing $4.50 a ton, and the pulverizer with slack coal at $4.30 a ton, coal cost will be $848 less per year for the pulverizer. Making allowances for other expenses, and assuming purchased power at 2¢ per kw.-hr., the annual total saving with pulverized coal (including fixed charges) is $431.

Additional advantages of the pulverizer are flexibility, ease of repair without waiting for furnace to cool, ease of changing over to oil or gas-burning.

While some pulverized-coal plants are justly charged with discharging excessive ash from the stack, there should be no more nuisance from this cause than with stokers, if the job is properly engineered. It is easier to prevent smoke with the pulverizer.

After completing this argument, Mr. Armour described a number of pulverized-coal installations in small boilers. With the expanding use of pulverized coal in small boilers, he looked for a wider application of automatic combustion control.

Discussing Mr. Armour's paper, one of the engineers present remarked that integral-gear small turbines consuming 1,400 lb. of steam per ton of coal pulverized are now available for driving pulverizers. He told of a pulverized-fuel-fired boiler in Cincinnati which is shut down with the factory whistle every night. The operators go home at once. On their return in the morning, 100 lb. steam pressure remains, enough to start the pulverizers and build up output in a few minutes. At closing whistle pulverizers are shut down, dampers and valves are immediately closed, bottling up the heat. He felt that the fly-ash problem is the most serious facing the small installation of pulverized coal. This calls for more work by manufacturers of dust catchers, probably also redesign of boiler surface and baffling to precipitate more ash within the setting.

He also told of a case where the burner under a small boiler was able to operate over a load range of 13 to 1.

Lack of application of water walls in small furnaces limits the application of pulverized fuel, because it does not permit this type of firing to develop its full efficiency. This opinion was expressed in a written discussion by Mr. Martin of Babcock & Wilcox Co. Purchasers, he said, are concerned primarily with the over-all performance of the complete steam-generating unit. Mr. Lincoln of Strong, Scott Co. submitted a written discussion stating the opinion that mass firing is obsolete, since pulverized firing alone permits close control of the fuel-air ratio and good mixing.

The opposite view was expressed in a written discussion by Mr. Beers of Detroit Stoker Co. His statistics showed that present-day applications of stokers in small plants are enormously greater than of pulverizers. The ratio was 50 to 1 in favor of stokers in 1931 (1889 stokers installed that year and 37 pulverizers) and grew to 100 to 1 in 1934. Among the drawbacks of pulverizer installations, he listed: difficulty in handling wet coal, power for pulverizing, need of more sensitive control, explosion hazard, lack of heat storage, fly ash, need for skilled operators, large furnace volume.

Canadian Electrical Ass'n

AT THE Algonquin Hotel, St. Andrews-by-the-Sea, New Brunswick, Canada, Canadian Electric Association held its 45th annual convention June 26-28. A wide variety of reports and papers were presented on engineering and other subjects of interest to the electric power industry. F. L. Lawton, Duke Price Power Co., chairman of the sub-committee on improvements in generator cooling, told how baffles were placed on the rotor of a 30,000-kva. vertical-shaft hydro-electric generator to improve its ventilation.

Tests have shown that from 6.2 to 12.6% additional load can be carried on a unit after

W. L. Batt
A.S.M.E. presidential nominee

equipping it with baffles, for the same average stator-iron temperature rise as measured by thermometers, at a total cost of $360. Moreover, there is also much less variation in the iron temperature around the stator.

Based on the tests, it is believed that possibly as much as 9% additional load can be carried for the same hot-spot copper temperature rise, so that the cost of the gained generator capacity will be about $0.15 per kva. If the generator had been dismantled solely for the purpose of installing the baffles, the cost of dismantling and reassembling, approximately $650, would have to be added, making a total of $1,000 for the job, or about $0.40 per kva.

Hydro Main Bearings

The report, "Recent Developments and Experiences With Main Bearings of Hydraulic Turbines," by B. K. Boulton, Beauharnois Power Corp., is essentially a compilation of manufacturers' statements, giving descriptions of and pointing out the particular conditions for which different types of bearings are suited. Bearings for hydraulic turbines are of two main types, water lubricated and oil lubricated. The former includes adjustable and non-adjustable lignum-vitae and rubber-lined bearings. Of 238 bearings built in the past ten years, 79% are water-lubricated and 21% oil-lubricated. It is Mr. Boulton's opinion that there appears to be an increasing trend toward the use of oil-lubricated bearings.

Corrosion of Materials

A report by J. F. Roberts, Power Corp. of Canada, on "The Corrosion of Materials and Protective Coatings for Materials in Contact With Water," reaches the following general conclusions regarding corrosion and its effects: The cost of really corrosion-proof material is still too high, relative to steel and iron, to permit their use for general engineering structures. Cast iron, especially if the skin is left on, is the most resistant among the cheaper materials. Genuine wrought iron sometimes shows advantages, but is often a disappointment. It seems somewhat better than cast iron under salt-water conditions, and better than steel under both salt and acid.

Soft waters with a pH value below 7, and usually with an acid reaction, will corrode iron and steel rapidly, and tubercles with possibly rapid local corrosion will be active under these conditions. Alkaline hard waters, with a pH value above 7, do not attack iron or steel appreciably.

Galvanizing or zinc plating forms an excellent protection for iron and steel, as long as the major portion of the surface is covered. It protects even though the covering may be cracked or chipped. Zinc is a good protection under most conditions, especially with alkaline solutions, but aluminum is better under very salty conditions. While galvanizing is the favorable commercial method of protecting at the present time, metal spraying appears to offer interesting possibilities.

Red lead and oil is the favored base coat for painting metals. A paint giving a stronger mechanical coating is favored for the last coat when exposed to air, and a bitumastic coating when submerged in water. A cement lining or coating will permanently protect steel and iron from most water conditions, such as salt water and salt and slightly acid water. The cement maintains an alkaline reaction at the surface of the metal. All electric or circulating currents must be kept away, as they are ruinous to reinforcing or bedded steel if moisture is present.

SPEAKING OF POWER

● JUNE is the month for brides and conventions. Power field conventions last month included Edison Electric Institute at Atlantic City, American Boiler Manufacturers' Association at Skytop, Pa., A.S.M.E. at Cincinnati, National District Heating Association at Philadelphia, American Society of Heating & Ventilating Engineers at Montreal, A.I.E.E. at Ithaca, Smoke Prevention Association at St. Louis, Canadian Electrical Association at St. Andrews-by-the-Sea, N. B. . . . There were also several borderline affairs with a paper or two of interest . . . Power covered all of these, mostly with editors on the spot; see pages 373-375, 384-385, 394-395 for some practical ideas picked up on the run.

The editor's chief function on these junkets is to sit through a lot of sessions and sift out the essence of things said and done as far as they are of practical interest to his readers . . . Saves them the time and money of going there in person. Just the same it would be fine if every reader could break away from his plant once or twice a year to attend an engineering convention. The personal contacts are worth a lot.

Convention thought: Captain Penn, of Public Service (N.J.) points to high-temperature steam and mercury "tops" (page 375) as the prime way to add low-cost utility capacity and increase efficiency at the same time. . . . But how about industrials? Wouldn't it pay some of them to reduce exhaust waste and generate more byproduct power by adding a high-pressure "top" to existing back-pressure, condensing or bleeding prime movers?

Now and then a reader asks, "How do you fill all those pages every month? If he only knew how editors fight with each other for space like a pack of hungry dogs for a bone! When they are on their jobs there is always five times as much good material as there is space for publishing it . . . Which, after all, is a good thing for the reader at least. It means endless selection and condensation, making every word count. No sane engineer wants to read everything. He wants the practical essence that will help him on his job, and he wants it quick and fast, with the non-essentials combed out and thrown away.

Speaking of space, I was a little put out not to find room for a page or two of romanticising about the sunny South, after driving through 2,750 miles of South and North Carolina, Georgia, Tennessee, Virginia. . . . I talked with scores of engineers in scores of plants and came back all steamed up over the South, its men, its plants, its towns, cities, mountains, rivers and plantations . . . It won't be easy to forget Charleston, or the mountaineer waterwheels in the "Old Smokies," or the up-to-date machinery and engineers in textile and tobacco plants.

Talking with consulting engineers down South, I got a new slant on condensing industrial plants . . . You know it has been said that the industrial steam power plant hasn't much chance where there is little opportunity to make byproduct power. Yet it is now possible, I am told, to build a straight condensing plant of 2,000 kw., say, for much less than $100 a kilowatt, and operate it on 1.3 lb. of good coal per kw.-hr. If so, the picture has changed for straight power generation with condensing turbines. If you can bleed additional steam for a substantial heating and process load, you have a sweet picture. Example: Clinton Cotton Mills in North Carolina (Sept., 1934, page 483).

One advantage of going South occasionally (or even to Northern cities in August) is that it wakes you up to air-conditioning possibilities. The whole of America may gradually become a summer resort as fast as money, engineering and business initiative bring in air-conditioning. Once well started, the idea of being comfortable the year 'round spreads like measles. . . . Smart engineers will know how to tune in on this public demand and make themselves more popular and necessary than ever. . . . Which reminds me that the June, 1936, meeting of the A.S.M.E. will be held in Dallas, Texas. And Dallas, they say, is going places.

Talking about the Normandie's power plant, a big New York newspaper, in a feature article, says, "Condensers perform their silent task of turning water into steam, which produces electricity to drive the ship . . ." . . . In giving the newspaper man the usual "ha-ha," we must not forget that condensers are, as a matter of fact, used to produce steam from which power is made. If you don't believe it, inquire into the mercury-steam power installations at Schenectady, Hartford and Kearny (page 348).

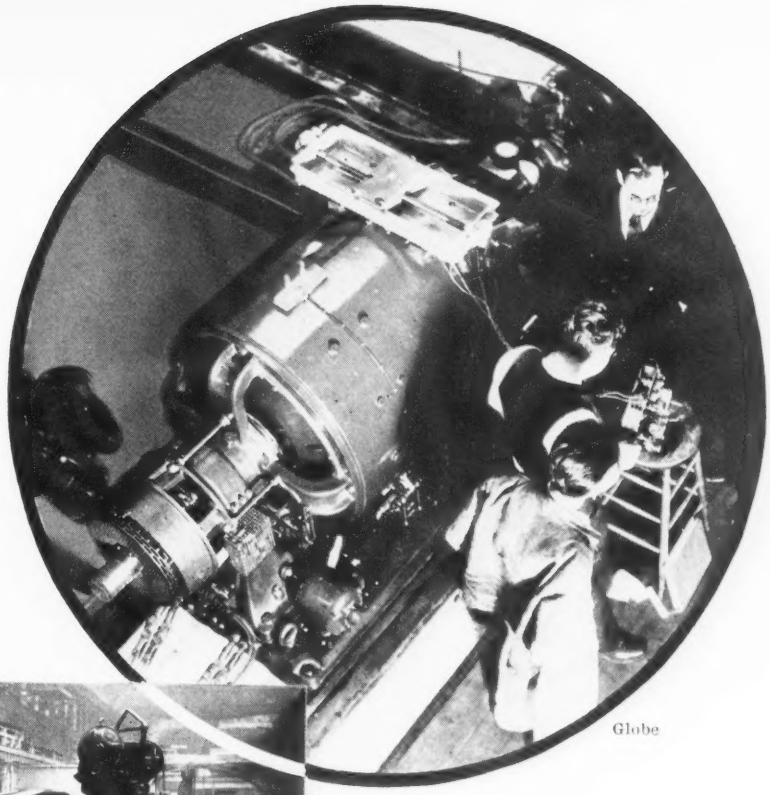
The Supreme Court's N.R.A. decision takes the ball away from the Administration and hands it over to business . . . Many say that the Administration will not try to get the ball back for a while, but rather "stump business to play the game without a Government umpire, and bet it can't." If it can't, or doesn't, business leadership will be discredited and the tables set for greater Government control . . . That's something for business men to think about right now.

Another thing is this: The Supreme Court's cancellation of N.R.A. will leave many an inefficient producer without a crutch. He'll have to stand, if at all, on his own feet. Labor is unlikely to let him cut wages or increase hours. If he raises prices his competitors will take away the business . . . There remains one way out: lower manufacturing costs. In these, power costs are a major controllable item.

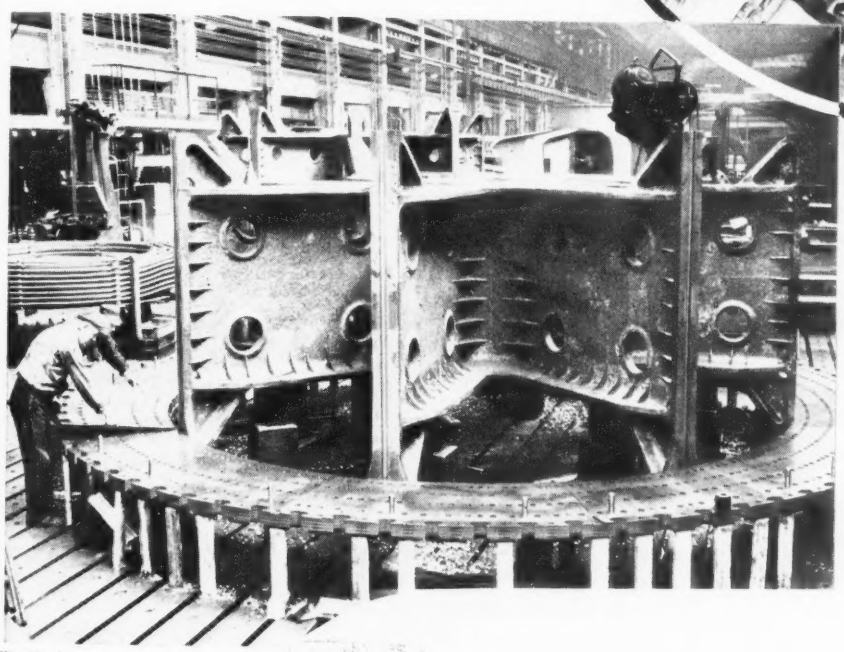
PHIL SWAIN
Editor

HYDRO
WAY OUT WEST

Three photographs here show progress on as many western hydro projects. At right is the new dynamometer which is testing Los Angeles Aqueduct pumps. Increasing their efficiency 1% will decrease power costs $50,000 a year. They will lift a billion gallons a day a total of 1,600 ft.



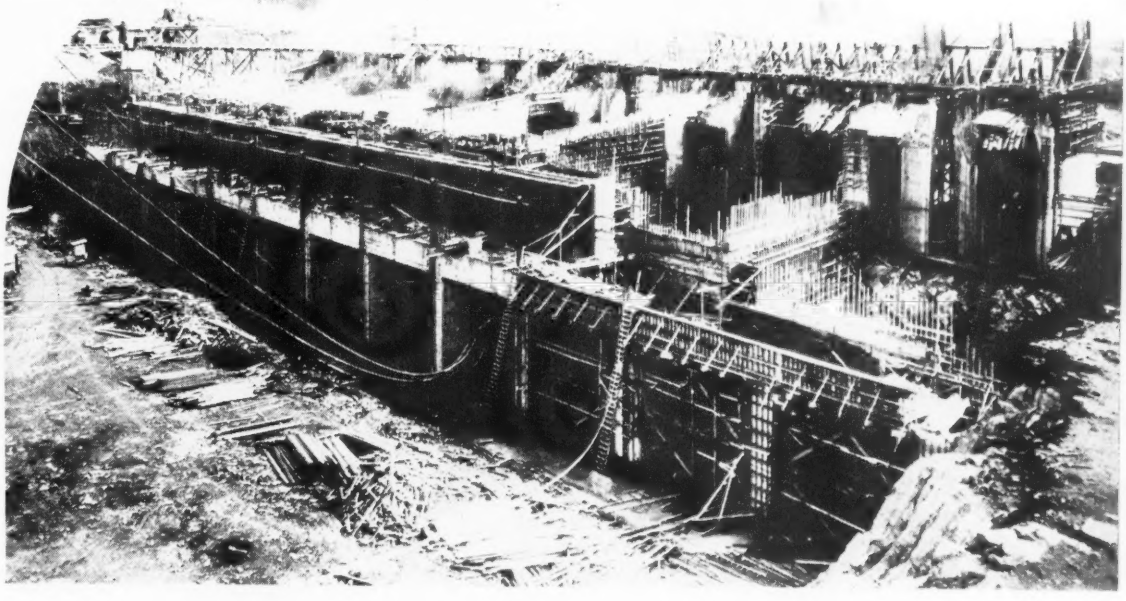
Globe

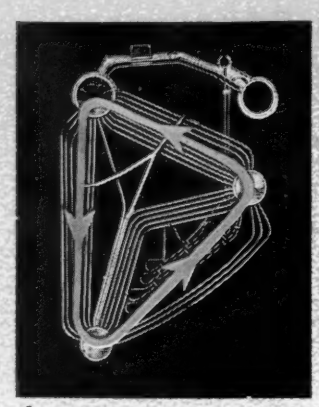


Westinghouse

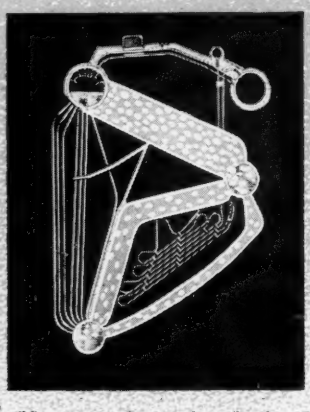
Left—65x34x½-in. lamination segments, weighing 50 lb. apiece, being stacked on the spider of one 82,500-kva. generator for Boulder Dam. About 600,000 lb. of segments are needed. Below—The 720,000-hp. (ultimate) plant under construction below Bonneville Dam on Columbia River. Two 60,000-hp. Kaplan turbines, largest of their type, will go in initially

Wide World

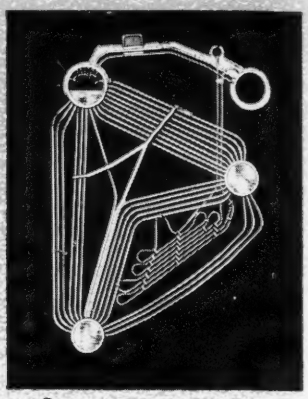




1 Minimum Resistance to Circulation



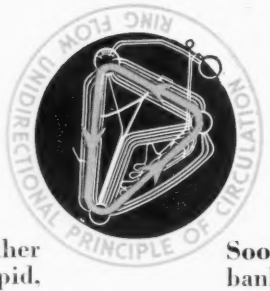
2 Maximum Force Producing Circulation



3 Uniform Steam Collection

These Distinctive Characteristics explain the very decided

The design of the Riley Boiler is based on the



1 Minimum Resistance to Circulation. The large areas provided through boiler tube banks reduce resistance to circulation to a minimum.

2 Maximum Force Producing Circulation. All tubes exposed to high temperatures carry upward flow of water and steam bubbles. This directional effect, together with the large head producing flow, insures rapid, positive circulation in a fixed direction in all of the tubes, with a very definitely increasing rate of circulation as the steam output increases.

The rapid circulation resulting from the above characteristics immediately removes all steam bubbles as formed, insuring proper intimate contact between water and tubes which, together with gas baffling of the most effective heat transfer, results in low flue gas temperatures.

3 Uniform Steam Collection. The steam is uniformly collected at low velocity by the overcomer tubes evenly spaced over the entire length of the drum. It is apparent that uniform distribution of steam to all superheater tubes also results from this design.

4 Dry, Slightly Superheated Steam. Overcomer tubes connecting the third and fourth drums entirely remove the slight residual moisture from the steam and deliver it dry and superheated 10 to 20 degrees F. to the fourth drum.

5 Proper Accessibility to Baffles and Soot Blowers. The arrangement of the tube banks of the boiler is such as to give proper accessibility to baffles and soot blowers. The tube bank arrangement also permits the location of the superheater elements so as to assure uniform temperatures over wide load ranges.

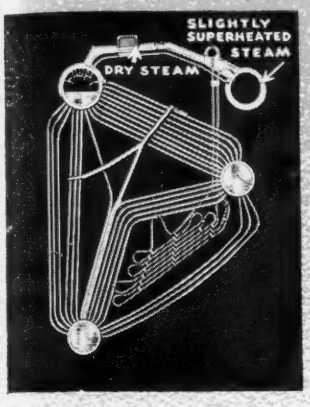
6 Cross Flow of Gases Over Heating Surfaces. Riley Boilers are baffled so as to obtain cross flow of gases over the heating surfaces with most effective heat transfer resulting. Baffling is so arranged and gas passages so proportioned as to result in unusually low draft losses and minimum exit gas temperature. Careful consideration is also given to provision for easy access for inspection.

In addition to the above and other distinctive features of design, you are assured, when purchasing Riley Steam Generating Equipment, of the highest quality materials and workmanship both in manufacture and erection. Unusual satisfaction, high efficiency, continuity of operation, and low maintenance result from these plus values. A visit to some of the recent installations of Riley Steam Generating Units will make these plus values perfectly apparent to you.

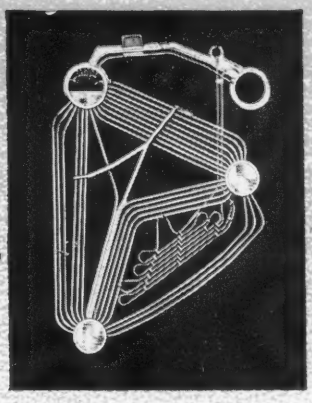
RILEY

STOKER CORPORATION - WORCESTER, MASS.

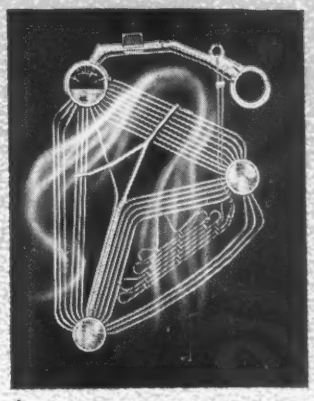
BOSTON NEW YORK PHILADELPHIA PITTSBURGH BUFFALO CLEVELAND DETROIT TACOMA ST. LOUIS CINCINNATI
CHICAGO HOUSTON ST. PAUL KANSAS CITY LOS ANGELES INDIANAPOLIS DENVER ATLANTA EL PASO SALT LAKE CITY



4 Dry, Slightly Superheated Steam



5 Proper Accessibility to Baffles and Soot Blowers



6 Cross Flow of Gases over Heating Surfaces

# of RILEY STEAM GENERATING UNITS to RILEY equipment

SWING—

RILEY RECORD

Some representative Installations of Riley Steam Generating Equipment in recent years

TITANIUM PIGMENT CO., Sayreville, N. J.
WEST VIRGINIA PULP & PAPER CO., Luke, Md.
PENNSYLVANIA SUGAR CO., Philadelphia, Pa.
BEECHNUT PACKING CO., Canajoharie, N. Y.
FORSTMANN WOOLEN CO., Garfield, N. J.
ARNOLD PRINT WORKS, North Adams, Mass.
SAVANNAH SUGAR REFINING CO., Savannah, Ga.
CRYSTAL TISSUE CO., Middletown, Ohio
GERMAN BREWERY, Cumberland, Md.
SHELL PETROLEUM CORP., Wood River, Ill.
NORTON COMPANY, Worcester, Mass.
GENERAL ANILINE WORKS, Rensselaer, N. Y.
PAPEC MACHINE CO., Shortsville, N. Y.
J. F. TROMMER, INC., Orange, N. J.
SCHMIDT BREWING CO., St. Paul, Minn.
PIONEER PAPER CO., Los Angeles, Calif.
U. S. NAVAL OPERATING BASE, San Diego, Calif.
TIMES BUILDING, Los Angeles, Calif.
MERCY HOSPITAL, Pittsburgh, Pa.
SUN YAT SEN UNIVERSITY, China
MARYLAND TUBERCULOSIS SANITARIUM, Sanitarium, Md.
IMPERIAL LAUNDRY, Newark, N. J.
BOSTON STATE HOSPITAL, Boston, Mass.
CITY OF DECATUR, Indiana
C. V. HILL CO., Trenton, N. J.
WORCESTER SALT CO., Silver Springs, N. Y.
LACKAWANNA LAUNDRY, Jersey City, N. J.
C. F. SIMONIN'S SONS, Philadelphia, Pa.
FORD MOTOR CO., Los Angeles, Calif.
STATE LAUNDRY, Brooklyn, N. Y.
FINCH PRUYN CO., Glens Falls, N. Y.
FAIRMONT CREAMERY CO., Columbus, Ohio
FOREST PRODUCTS LABORATORY, Madison, Wis.
CASCADE LAUNDRY, Brooklyn, N. Y.
COLUMBIA UNIVERSITY, New York City
COLLINS & AIKMAN CORP., Philadelphia, Pa.
AMERICAN OAK LEATHER CO., Louisville, Ky.
CONTINENTAL DISTILLING CO., Philadelphia, Pa.
AMERICAN HAIR FELT CO., Peabody, Mass.
CARBON & CARBIDE CHEMICAL CO., S. Charleston, W. Va.
WEST VIRGINIA PULP & PAPER CO., Covington, Va.
GENERAL ANILINE WORKS, Grasselli, N. J.
PUBLIC SERVICE ELEC. & GAS CO., Paterson, N. J.
FORSTMANN WOOLEN CO., Passaic, N. J.
CROMPTON & KNOWLES LOOM WORKS, Worcester, Mass.
INTERNATIONAL BUSINESS MACHINES CO., Endicott, N. Y.
AMERICAN LAUNDRY MACHINERY CO., Rochester, N. Y.
WORCESTER POLYTECHNIC INSTITUTE, Worcester, Mass.
UNION ELEC. LT. & POWER CO., St. Louis, Mo.
CHARLTON WOOLEN CO., Charlton, Mass.
SHANTUNG FLOUR MILLS, China
LACLEDE POWER & LIGHT CO., St. Louis, Mo.
J. F. TROMMER, INC., Brooklyn, N. Y.
DEGISE SILK DYEING CO., Paterson, N. J.
MONROE SILK MILLS, Stroudsburg, Pa.
AMES WORSTED CO., Southbridge, Mass.
U. S. NAVY DEPARTMENT, Los Angeles, Calif.
ROME STATE SCHOOL, Rome, N. Y.
PENNSYLVANIA R. R., Newark, N. J.
W. C. HAMILTON & SONS, Philadelphia, Pa.
GARDNER RICHARDSON CO., Middletown, Ohio
CINCINNATI RUBBER MFG. CO., Cincinnati, Ohio
U. S. NAVY YARD, Portsmouth, N. H.
OTTER TAIL POWER CO., Washburn, N. D.
KIECKHEFER CONTAINER CO., Delair, N. J.
FORT WAYNE STATE SCHOOL, Fort Wayne, Ind.
GOLDEN GATE CREAMERY, Los Angeles, Calif.
SOUTH DAKOTA COLLEGE OF AGRICULTURE, Brookings, S. D.
ST. VINCENT'S SEMINARY, Philadelphia, Pa.
NATIONAL GRAIN YEAST, Belleville, N. J.
PHILADELPHIA WAREHOUSE & COLD STORAGE CO., Philadelphia, Pa.
HEWITT BROTHERS SOAP CO., Dayton, Ohio
HENRY H. SHEIP MFG. CO., Philadelphia, Pa.
CONTAINER CORPORATION, Philadelphia, Pa.
JACOB DOLD PACKING CO., Buffalo, N. Y.
LARGE EASTERN OIL REFINERY
KALAMAZOO VEGETABLE PARCHMENT CO., Kalamazoo, Mich.
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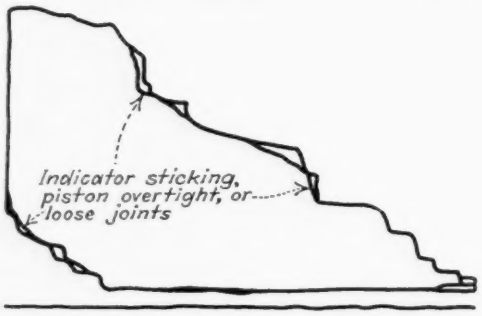
Scale drawings of recent Riley Installations will be gladly sent you upon request

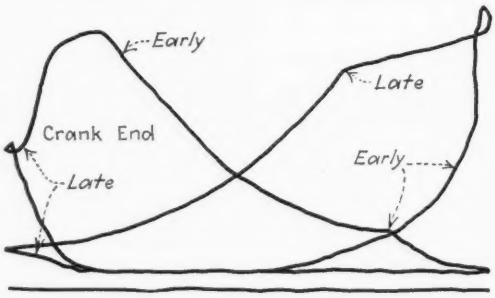
COMPLETE STEAM GENERATING UNITS

BOILERS • SUPERHEATERS • AIR HEATERS • ECONOMIZERS
WATER COOLED FURNACES • STEEL CLAD SETTINGS
PULVERIZERS • BURNERS • ALL TYPES OF STOKERS

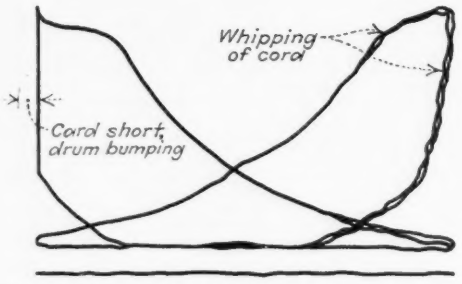
Number 34

Indicator Diagrams—Single-Valve Steam Engine

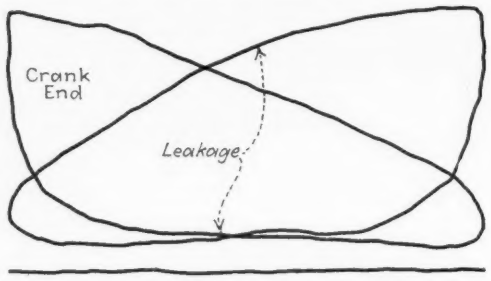




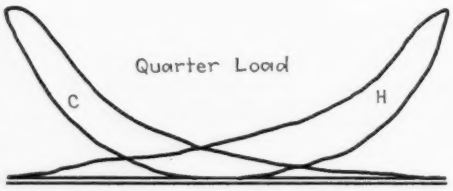
VALVE SET TOO CLOSE TO CRANK END

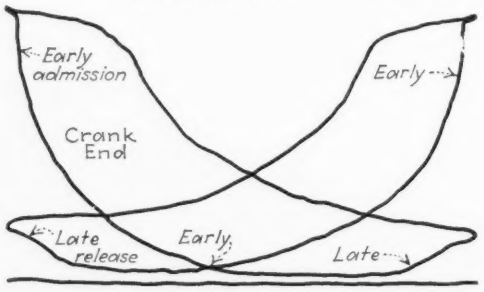


TWO CARDS ABOVE SHOW FAULTS DUE TO IMPROPER SET-UP OF INDICATOR

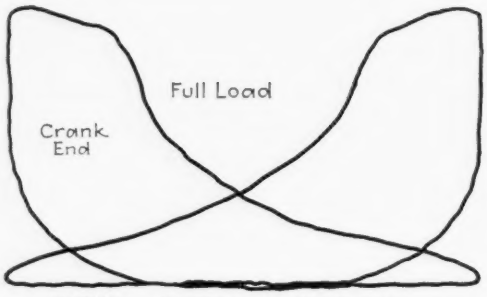


ABNORMAL EXPANSION AND EXHAUST LINE, INDICATING STEAM LEAKAGE PAST PISTON, VALVE OR BOTH

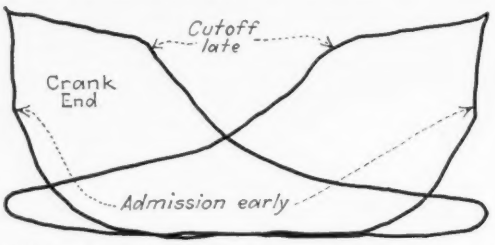




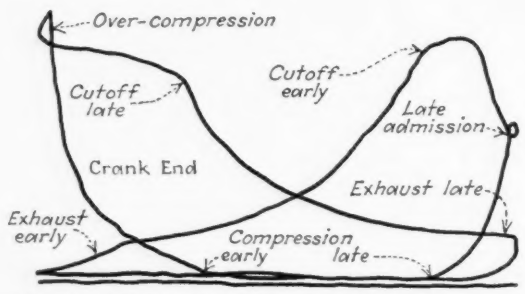
TOO SMALL STEAM LAP AND PROBABLY TOO NARROW PORT EXCESS EXHAUST LAP INDICATED BY TOO MUCH COMPRESSION AND LATE RELEASE



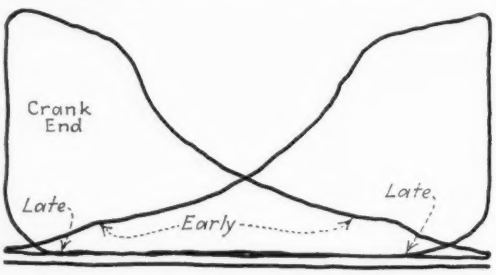
NORMAL ENGINE DIAGRAMS AT QUARTER AND FULL LOAD



CONDITIONS RESULTING FROM TOO LITTLE STEAM LAP



VALVE SET TOO FAR TOWARD HEAD END

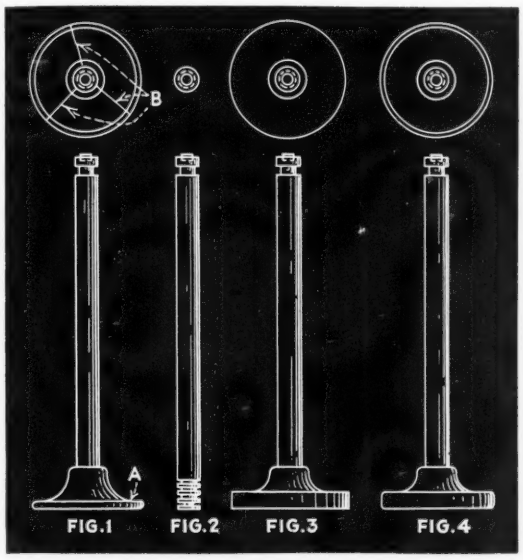


CONDITIONS RESULTING FROM TOO LITTLE EXHAUST LAP

Diagrams courtesy Elliott Co.

© POWER

PRACTICAL AIDS TO OPERATION



Puts New Disks on Old Valve Stems

FREQUENT facing and grinding reduced the thickness of the valve disks in our 300-hp. diesel engines until replacement was necessary. Instead of purchasing new valves and stems, we decided to renew the disks on the old stems. Figs. 1 to 4 show how this was done. We sawed the valve disks in three, as at *B* Fig. 1, and then broke them from the stems, Fig. 2. Disks were then cast onto the old stems, Fig. 3, and machined to their original size, Fig. 4. The job was done at about one-fifth the cost of new valves and stems.

Care must be exercised when breaking the disks from the valve stems to avoid bending the latter. Bent stems can be straightened, however, between lathe centers. We have used stems straightened this way with entire satisfaction.

Fort Valley, Ga. R. A. HALL

Thermostatic Traps Drain Standby Turbines

A CONTINUOUS supply of boiler feed water is of great importance in modern power plants. The small water-storage space in high-pressure steam-generating equipment makes interruptions of feed-water supply dangerous, even though of very short duration. To insure prompt restoration of feed-water pressure in case of failure of a boiler-feed pump, emergency boiler-feeding equipment must always be available. This equipment must be readily adaptable to quick starting and its characteristics such that feed-line pressure can be restored quickly.

In a large industrial power plant, non-condensing steam turbine driven boiler-feed pumps are held in standby service. To avoid possible harmful expansion strains incidental to quickly bringing these turbines up to speed from a cold start, in cases of emergency, the exhaust line valves are always left open. Maintaining exhaust-line steam pressure in the turbine casing avoids any difficulty from cold starting.

The presence of steam in the turbine while in standby service requires continuous drainage of condensation from the lowest points of its casing. This is done by thermostatic steam traps in the drain lines. These traps have bypass valves to insure adaquate drainage when bringing the turbines up to speed.

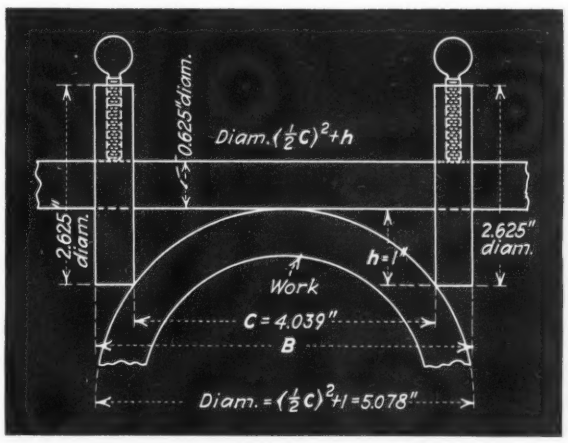
Waynesboro, Va. S. H. COLEMAN

Tool for Measuring Circular Sections

SOMETIMES the correct diameter or radius of a circular section is required but cannot be measured with a caliper or micrometer. Several methods and devices have been used for this purpose, but most of them employ intricate formulas, and some of the devices are difficult to make. A relatively inexpensive tool is shown in the figure, used in connection with a simple formula for finding the diameter of a circular section where the center is not accessible.

The tool consists of a 12-in. piece of $\frac{5}{8}$-in. drill rod on which are placed, with a good sliding fit, two steel collars 2.625 in. in diameter. The collars can be held anywhere on the rod by thumb screws, which should be of brass to prevent marring the rod. The collars are preferably hardened and ground and their inside faces have sharp corners.

To use the tool, place it on the piece to be measured and



adjust the collars until they and the rod just touch the work, as in the figure. Then measure distance *C* between the collars with an inside-micrometer, or measure distance *B* with an outside micrometer or vernier caliper and subtract the combined thickness of both collars, obtaining *C*.

Then use the formula:

Diameter $= (\frac{1}{2}C)^2 + b$ (which is $(\frac{1}{2}C)^2 + 1$ on this device). In other words the diameter is found by multiplying one-half distance *C* by itself and then adding 1, which is simple enough. For example: *C* is found to be 4.039 in. Then, $\frac{1}{2}\ C = 4.039 \div 2 = 2.0195$, from which the diameter is $(2.0195 \times 2.0195) + 1 = 5.078$ inches.

When taking measurements, place a piece of tissue paper, which is usually 0.001 in. thick, under the rod where it touches the work. Tighten one collar and move the other with a twisting motion toward the work. When it touches,

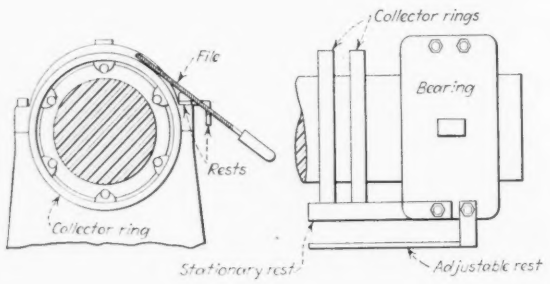
tighten its thumb screw. Press lightly on the instrument. When the tissue paper can just be pulled out without tearing, the adjustment is correct. The thumb screws need not be in line when the measurements are taken. With the instrument shown, diameters from 2 to 12 in. can be determined accurately. For larger diameters it is better to make another gage with larger collars and a heavier rod to prevent the rod from bending which would give an untrue reading.

Highland Park, Mich. PAUL C. BRUHL

Uses File on a Rest for Truing Collector Rings

COLLECTOR rings of an alternator, synchronous motor, or slip-ring motor that are out of round cannot be brought to shape again with a stone, as can a commutator, without considerable trouble and expense. In the first place, it is difficult to hold a stone sufficiently steady against the brush rigging, owing to the assembly of the rigging to allow the stone to wipe the high spots on the ring. Rings sometimes are made of cast iron or an alloy so hard that the stone wears away rapidly.

A method for truing rings quickly and economically, comprises a 14-in. flat file and two iron rests, as shown. The stationary rest is straight, and the adjustable one is bent to conform with the bearing assembly to which they are fastened. With the collector ring revolving toward the operator, the file is held firmly in one position until the high spot or spots are ground even, after which the ring should be polished with a stone.



Nipigon, Ont. H. E. STAFFORD
Electrical Supt.
Nipigon Corporation

Balancing Exhaust Steam With Hot-Water Demand

HOT WATER supply is always a problem in the small laundry. When starting, water temperature is so low that live steam must be used in the exhaust. Near the end of the day, the water is too hot to condense the exhaust, and is wasted.

When water temperature reaches about 180 deg. F., an approximate balance exists between available exhaust steam and hot-water demand. Additional heat supplied by live steam at the beginning of operations increases the subsequent hot water temperature, makes the balancing temperature possibly in excess of 212 deg. F. Studies made of conditions in a local laundry indicate that this difficulty can be corrected at little cost, as in the diagrams. (All valves are omitted except those used for control).

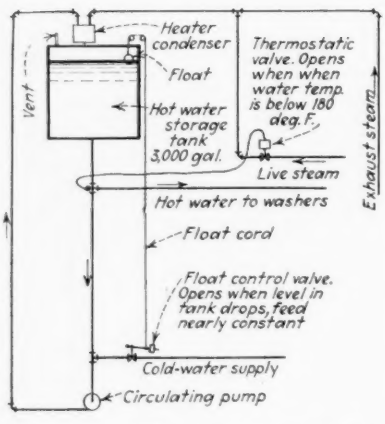
Fig. 1 shows a typical hot-water system which permits water level to rise to maximum level before stopping cold-water inflow. The water is kept hot by exhaust and live steam. The control in this case functions to maintain constant water storage volume.

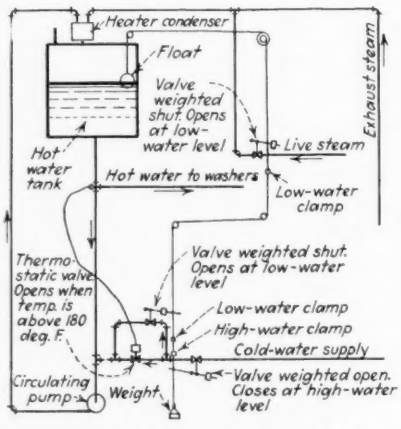
Fig. 2 shows the same system altered to permit variation in water volume. Water is heated by exhaust only, unless the low-water limit is reached. When the latter occurs, live steam is admitted to heat the water passing through the bypass around the thermostat-controlled valve. As long as the stored water has a temperature above 180 deg. the thermostatic valve remains at least partly open. If demand for hot water is less than inflow, the water level rises until the high limit is reached, then the float-controlled cold-water valve closes.

A suggested simplified method of accomplishing the results, Fig. 2, is indicated in Fig. 3, but requires a specially designed combination thermostat- and float-control cold-water valve. The thermostat of this valve should provide full-range throttling or have at least one stopping point between full-open and full-closed positions.

With the system in Figs. 2 and 3, a small amount of water is heated to start the day's run. This gives a more rapid rise in water temperature and requires less live steam. Water goes to the washer at not less than a fixed minimum temperature, consequently no live steam is required after starting unless water demand becomes excessive. The possibilities of overheating or underheating the water are removed within the limits of tank water-levels.

Milwaukee, Wis. A. G. BEHLING
Engineering Service Co.


Heater condenser
Float
Vent
Thermostatic valve. Opens when when water temp. is below 180 deg. F.
Hot water storage tank 3,000 gal.
Exhaust steam
Live steam
Hot water to washers
Float cord
Float control valve. Opens when level in tank drops, feed nearly constant
Cold-water supply
Circulating pump



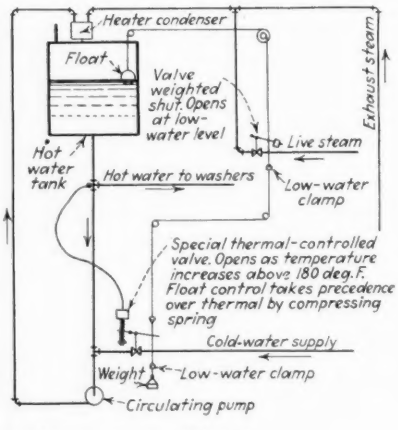


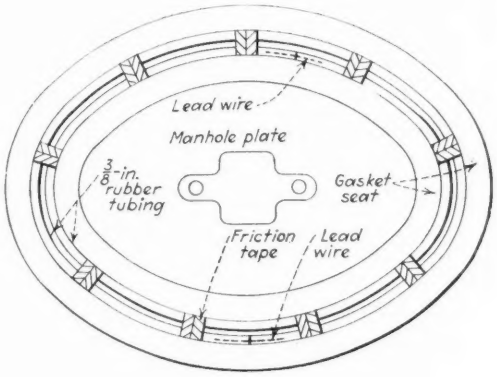
Fig. 1 (Left)—This arrangement maintains constant storage volume water. Fig. 2 (Center)—Same as Fig. 1, but altered to permit variation in water volume. Fig. 3 (Right)—Simplified form of Fig. 2, but requires a special cold-water valve.

Voltage Affects D.-C. Machine Parallel Operation

A NEW switchboard was installed in a small d.-c. plant which had two motor-generator sets arranged for parallel operation. After the changeover the machines would not divide their load as formerly. One seemed to "hog" the load, particularly when there were heavy swings. We checked the wiring, but could find no errors or poor contacts. We did find that it took one machine longer to respond to changes in rheostat setting than the other, indicating that one was operating higher on the saturation curve.

The machines were operated at 230 volts, but were designed for 250 volts. If they were operated at 250 volts, both would be well up on the saturation curve and their voltage characteristics more nearly equal. Parallel operation was satisfactory, but the engineer questioned the idea of boosting voltage 10%. A check was made of the voltmeter on the old switchboard, and it was found that 230 volts on it equalled 250 volts on the new one. The voltage was raised to the higher value and parallel operation became satisfactory. Normal operation of a d.-c. generator can be expected at rated voltage only.

Montague City, Mass. MAX PAFENBACH



Rubber Tubing for Manhole Gaskets

SOMETIMES manhole gaskets start leaking unexpectedly, and a new gasket is not readily available. This problem has been solved by using $\frac{3}{8}$-in. thick-walled rubber tubing, as shown. The ends of the tubing were joined with a short piece of soft lead wire and the tube supported in place by friction tape. For hand holes, one length of tube is sufficient. This method has been used successfully for pressures up to 150 lb.

Greenville, S. C. S. A. WARREN

Watch That Water Column

IT IS essential for safe boiler-plant operation that the operator pay particular attention to water columns and gage glasses. While the following suggestions are as a rule well understood in the larger plants, there are many smaller plants where they are neglected:

The boiler operator of each shift should blow down the water columns and gage glasses as one of his first duties. Blow-down valves should be operated individually and not together to permit separate observation of the action of the column and glass. Blowing down will remove loose sediment which in time would accumulate and obstruct the lower connections. Observe the action of the water when closing each blow-down valve. Because of sluggish circulation through the water connections, scale may form in these pipes and fittings. The 1.5-in. pipe connections to water columns have been found nearly filled with scale. Fortunately, this condition may be discovered before it becomes dangerous by proper interpretation of the water action.

When the water-column blow-down valve is closed, you may observe that considerable time is required for water to rise to normal level in the glass. If this condition is found, one of the lower connections is obstructed. The glass should then be blown down and the action of the water again noted. If the water is still tardy in returning to the glass, it indicates that the lower glass connection or short nipple to the column is obstructed. As a still further check on this condition the column may be blown down, and the try-cocks will show correct water level shortly after closing the blowdown valve even though water has not risen into the glass.

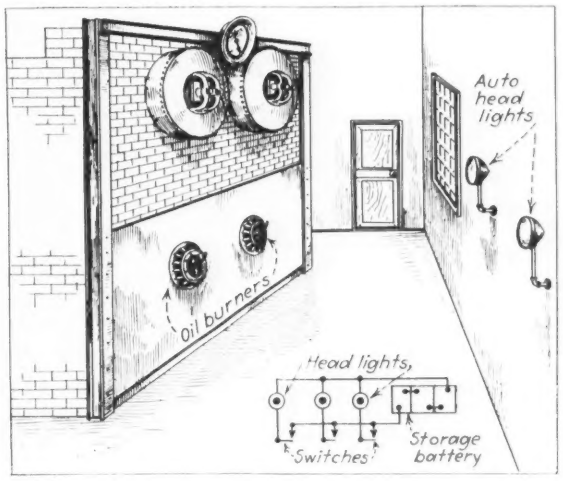
If water does not return promptly when the water column drain is closed but it does function properly when the gage-glass drain is closed, the trouble should be found in the piping between water column and boiler. Ofter this trouble is caused by soft sludge or mud entering this pipe where it connects with the boiler drum. The faulty connection or piping should be taken down as soon as possible and either cleaned out or renewed. If this is not done, the obstruction may become serious enough to show a false water level and possibly an explosion from overheating the boiler.

Philadelphia, Pa. C. A. ARMSTRONG

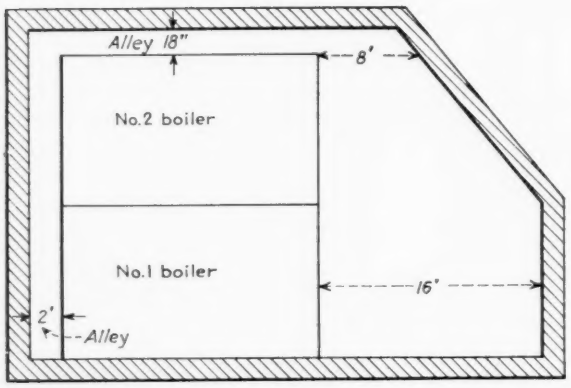
Emergency Lights for Boiler Room

IN A boiler plant where the power for lights had failed and left the operators in darkness it was decided to install an emergency lighting system. For this purpose 6-volt automobile headlights and a storage battery were selected. The head lights were mounted on swinging brackets on the wall in front of the boiler, as in the figure, and each connected through a snap switch to the battery. Now, if the power fails, the emergency lights can be switched on with little inconvenience to the operators.

Montreal, Que. J. E. WRIGHT



CURRENT COMMENT



Bends Tubes to Install Them in Boiler

I HAVE been reading about putting tubes in two sections into H. R. T. boilers. This brings to mind some of my experiences. In one plant, two H. R. T. boilers with 16-ft. tubes were installed in a room with free space around them, as in the diagram. After a considerable period of operation, tubes began to leak and had to be replaced. The 16-ft. space in front of No. 1 boiler was sufficient to put tubes in it conveniently. In front of No. 2 bolier the space sloped off to 8 ft. which obviously would not allow putting a straight 16-ft. tube in. The problem was solved by curving the tubes so that they could go through the holes in the front header and then straightening them as they passed into the boiler. These tubes gave no trouble, they passed inspection and stood up in service as well as those installed straight.

Springfield, Mass. E. A. GILBERT

Dial Gage Checks Alignment

ALIGNMENT of a motor-generator may be checked and corrected with rotors in place, as discussed in June, by leveling both rotors. If there is a directly connected exciter with an outboard bearing, mark the coupling face with a center punch or chisel, the marks to be used as reference points. Disconnect the two halves of the coupling and separate them as far as possible.

With the reference marks together, measure the gap between the two coupling faces, near their circumference, with feelers or inside micrometers if the gap is great enough. There should be at least four readings taken at points 90 deg. apart, starting at the top. When these readings are all the same, the two rotor shafts are parallel but not necessarily concentric. If the two halves of the coupling are not equal distances apart at all points, they may be made to agree by shifting a pedestal bearing. The proper pedestal to adjust can be determined by observing the measurements taken. With the two shafts level, the top and bottom gaps in the coupling should be the same; if not raise or lower a bearing to obtain the desired results.

After the rotors are made parallel to each other it is necessary to make them concentric. Clamp a dial indicator near the punch mark on one coupling half with its button resting on some machined concentric section of the other half. Adjust the indicator so that it is about mid-position of its travel and turn dial to zero or half its scale if you wish to eliminate positive and negative readings.

With the indicator face up and on top of coupling and with punch marks together, read the indicator and record the reading. Turn motor and generator shafts 90 deg., bringing reference marks together again, read the indicator and record. Continue until readings are taken at top, left side, bottom and right side. If all readings are alike, the two couplings are concentric and the two rotors are properly aligned. In case the indicator measurements are not the same, move both bearing pedestals an equal amount on either the motor or generator until they agree.

With motor-generator sets having rigid bearings, the pedestals may be twisted slightly so that the load is unequally distributed on the bearings. Correct for this twist by using Prussian blue on the journal to determine the rubbing points.

Tighten down the pedestal bolts but don't dowel. Align exciter bearings in the same manner as for the motor-generator proper. When properly aligned, tighten coupling bolts on exciter. Check motor and generator air gaps and correct if out. Make a final check at the coupling after all bolts are tight. If the check is satisfactory, redowel and put in coupling pins. The set is now ready to run.

Augusta, Ga. R. C. BAKER

Precipitator vs. Cyclone

THE data in Mr. Kreisinger's discussion on page 123 of the March number does not afford an easy method of judging the respective merits of the methods of catching solids in stack gases. For instance, it states that the precipitator will require 50 kw. of additional power for a plant producing 100,000 kw. The cyclone, on the other hand, will require 10 kw. for a plant producing 100,000 lb. of steam. Unless one does a little figuring, it is not possible to know which system requires more power.

Assuming 15 lb. station steam rate, 100,000 lb. of steam is equivalent to about 6,600 kw., and if the same proportion will hold for a 100,000 kw. plant, the cyclone will require 150 kw. or three times as much as the electric precipitator.

Since cost of the electric method is $2 a kilowatt of station capacity, the total cost will be $200,000. Cost of the cyclone, assumed at 55% of the electric, will be $110,000. At $100 a kilowatt for the power to drive, the electric will require $5,000 and the cyclone $15,000 additional. From the data given I have prepared the table for a 100,000-kw. plant.

Relative Costs of Cinder Collectors

	Precipitator	Cyclone
1. Power required, kw.	50	150
2. Investment for power at $100 per kw.	$5,000	$15,000
3. Cost of system	$200,000	$110,000
4. Total cost	$205,000	$125,000
5. Annual power consumption, 24 hrs., kw.hr.	440,000	1,320,000
6. Annual cost of power at ½c. per kw.hr.	$2,200	$6,600
7. Fixed charges at 15%	$30,900	$18,700
8. Total annual cost	$33,100	$25,300
9. Per cent collection	90	80

Expressed in one sentence, the electric system costs 20% more and is 10% more effective.

Chicago, Ill. N. T. PEF

How Diesel Plants Purify Oil

I SHOULD like to add the following to the answers to Question 2 by "J.J.K." in the April issue of *Power*.

Trunk-piston engines are likely to have carbonaceous and unburned matter deposited in the crank-case from the fuel oil and some from carbonization of lubricating oil. Dirt and dust from the atmosphere and moisture from the cooling jacket are also, in some cases, deposited in the oiling system. Impurities of this nature create a fertile field for formation of emulsions; the foreign matter not only aggravates emulsion formation but retards separation of the oil from an oil-water mixture. Circulation and agitation of this mixture, with the attendant temperaures, then produces sludge. Oil in the crankcase of double-acting and some single-acting engines is not exposed to the same risk of mixture with foreign matter from cylinders, but there is always the possibility of the oils oxidizing after long use. As oxidation causes sludge deposits to collect, precautions must be taken to prevent them from endangering bearing surfaces by lack of lubrication.

During 1932, out of a total of fifteen diesel installations ranging from 1,000 to 7,000 hp., all used the centrifuge method of purifying lubricating oil; twelve of these used centrifuge alone, while three used the centrifuge in addition to filtering and settling. Seven out of eleven in the 500- to 1,000-hp. class used the centrifuge method. In the 250- to 500-hp. class, out of thirteen reporting, four used centrifuge and nine filtration. Practically all installations in the capacity range 5 to 250 hp. use the filtration method of purification.

The two chief considerations to be observed in purifying oil in a centrifuge are that the oil is sufficiently fluid for separation to occur and, that the rate of flow through the centrifuge is not too rapid to permit separation to take place. The first factor can be met by reducing the viscosity of the dirty oil by heating it, and the second by close observation in individual cases. Light oils need not be heated to the same degree as those of higher viscosity; the average diesel oil will probably require heating to between 180 and 200 deg. F. for the most satisfactory results. After the clean oil leaves the centrifuge, it is passed through a cooler and then to the engine at the required temperature.

Kingsport, Tenn. BENJAMIN E. LINGAR

Tips on Diesel Centrifuging

WE OPERATE a Sharples centrifuge (17-g.p.h. capacity) in the oil circuit of our plant, taking oil continuously from the return line of the reservoir. Centrifuged oil is returned to the top of the reservoir. We carry 125 gal. of oil in the circuit, although we can operate on much less due to the capacity of the oil cooler.

We change oil about every six weeks. Then all oil is recleaned, requiring about 72 hr. During this time the centrifuge is of course not in the engine circuit. After the engine has operated for 72 hr. on the new oil, we can remove about 7 lb. of sludge and wax every 24 hr. In six weeks this drops to 3 lb., the drop being particularly noticeable when we start to add reclaimed oil to the circuit.

Our engine is entirely free from sludge deposits. After four years of operation, we installed new wristpins and bushings and cleaned out the inside of the oil-cooled piston head. The carbon was soft and easy to clean out.

We purchase oil from a local independent, and we are not getting the best oils, nor do we have the advantages of consultation with a lubrication engineer. We have operated our engine under overload since erection, and oil consumption was heavy until we got relief from a hydro plant. We put a vent in the line from the centrifuge and found that there is a continuous vapor passing off. Since the vent was put in we can keep viscosity better.

Atlanta, Idaho. DEWEY M. DEMPSEY

More on Centrifuging

I WOULD like to add to the comments on J.J.K.'s question regarding centrifuging diesel lubricants, answers to which were published in June. I am assuming that the engines are run week about and that they have sump tanks with a screened partition between outgoing and returning oil. The purifier pump is connected to the lowest point of the "dirty" end of the tank. Oil should be taken from the idle engine, as it has a better chance to settle. It should be put through the purifier until little or no carbon appears in the bowl when it is it opened for cleaning.

Oil going through the purifier should be heated to about 130 deg. F., either with an electric heater or with hot water from the exhaust manifold. After three or four months of use, oil should be removed from the sump tank, heated to 180 or 200 deg. F. and allowed to settle. The sump tank should meanwhile be cleaned, the foot valves examined, then the oil is returned through the centrifuge, care being taken not to return sediment from the bottom of the tank in which the oil was heated.

With the disk-type centrifuge, it is good practice to inject a shot of water about once an hour. This helps to wash the purifier and maintains the water seal. Water should be 130-160 deg. F.; cooler water will cause the oil to emulsify.

If the engine has oil-cooled pistons, the oil will require more attention. If electric heaters are used, I would suggest a 5-kw., 220-volt unit run on the "low" position. This will give sufficient heat at low surface temperature, thus preventing carbon formation on heater elements.

Hudson, Mass. G.D.N.

Not Bonus, But Interest

ON PAGE 258 of the May number N. T. Pef describes a bonus system used by him. I don't doubt that Mr. Pef devised the system with the best of intentions, but, it seems that the reward offered was hardly the real incentive that brought up the efficiency. He must have had ambitious and intelligent men or they would have never raised the efficiency for a paltry maximum of $100 per year.

If his saving was from $10,000 to $15,000 a year, it would seem much fairer to the men who saved this money, that they get a little more notice that the $25 prize offered each quarter to be divided among six men.

Average firemen and water tenders in large plants are usually intelligent men, interested in their work. They have a keen interest in efficient performance of the plant they are operating. They have ambitions to better their position in their chosen field.

It has been my experience that raising the weekly pay of men who do good work does more to increase the morale of the whole crew than any bonus system yet devised.

Rosedale, N. Y. JOSEPH O'BRIEN

DISTRICT HEATING ENGINEERS OPTIMISTIC AT PHILADELPHIA MEETING

NATIONAL District Heating Association opened its 26th Annual Convention at the Bellevue Stratford Hotel, Philadelphia, Pa., June 11, with a more optimistic atmosphere than for several years previous, having experienced a 5.11% increase in steam sales. A great deal of attention was devoted to means for improving customer relations and ways to obtain new users of district steam. One company reported in an effort to gain new customers it was offering to pay the entire cost of underground service connection, piping changes in the customer's building and suitable automatic temperature control, provided the total cost of the work does not exceed 50% of the estimated annual revenue.

Standard Steam Usage

Results of a study made to determine methods in use for calculating probable steam usage with the idea of evolving a standard were reported by G. H. Tuttle. This survey showed that the 65-deg. day was used by most companies. Some referred this to steam consumption per square foot of equivalent radiation, others to gross building volume and volume of heated space. The author expressed the belief that steam consumption per deg. per 1,000 cu.ft. of heated volume was the most satisfactory unit to use and that 1 lb. per deg.-day per sq.ft. of radiation was least satisfactory.

In discussion, E. Seiter pointed out that with average 47-deg.-day weather it is possible for a building to waste 60% of the steam in overheating.

Penn State Results

R. G. Segworth presented the results of heating steam consumption and temperature records on 30 buildings on the campus of Pennsylvania State College. Steam for heating is supplied from the exhaust of turbine-generators which operate in parallel with central station service and are loaded according to demand for heating steam. No noticeable time lag was found between drop in outside temperature and drop in steam load.

Record of steam consumption per deg.-day per 1,000 cu.ft. of heated building volume was kept daily for each building. Heating systems in all buildings were more efficient during cold weather than in warm. With automatic temperature control, efficiency in warm weather more nearly approached cold-weather efficiency. In the best buildings, steam consumption varied from 0.7 to 1.5 lb. per deg.-day per 1,000 cu.ft. for different degree-days; average for the campus was 1 to 3 lb. per deg.-day per 1,000 cu.ft.

Corrosion from O_2 and CO_2

T. J. Finnegan presented the result of laboratory work done to determine the relative corrosive effects of oxygen and carbon dioxide dissolved in condensate. Apparatus was designed so that water containing constant quantities of dissolved gases circulated over test samples of bessemer steel wire wound in a helix having dimensions and characteristics previously reported by J. H. Walker. It was found that 1 p.p.m. of oxygen had the same corrosive effect as 20 p.p.m. of CO_2.

As part of the Research Committee Report, A. R. Mullen presented a paper on cell concrete for use in insulating distribution steam mains. Curves were included showing how thermal conductivity varies with the density of the material, and comparing the insulating value of a concrete of 15.9 lb. per cu.ft. density with other insulating materials.

Two types of construction have been used in Europe. In one a concrete pad is laid, the pipes installed on the pad, cell concrete poured in a wood form around the pipe and then a 1-in. reinforced plaster applied. In the other a reinforced-concrete conduit is used as the form into which cell concrete is poured, and a reinforced-concrete slab laid on for the top, sealed with overflowing cell concrete and then waterproofed.

G. D. Winans in discussion reported 1¼-in. vertical movement of a 16-in. pipeline and that no way had been devised to use cell concrete that would provide for such vertical movement.

Steam-Jet Refrigeration

A. R. Mumford presented a paper that dealt with operating economies and control of steam-jet refrigeration. Test data on two 180-ton steam-jet refrigeration units showed the decrease in steam consumption with increased chilled water temperature and that partial-load operation with full initial steam pressure causes steam consumption per ton to increase rapidly as load decreases.

Earlier installations were designed to chill water to a constant temperature of 45 deg. and to supply this water to the air washer in varying amounts necessary to maintain spray-water temperature. If instead, flow of chilled water to the air washer is kept constant and temperature of chilled water is changed to meet varying air-washer load, advantage can be taken of decreased steam consumption at higher chilled-water temperature. Likewise sprays in the chilled-water tank will be maintained instead of being made ineffective at low loads due to decreased flow of water.

By placing the thermostat controlling the automatic booster in the return chilled-water line the machine would refrigerate down to a temperature which would take care of existing load.

Test data and operating experience indicate that the increase in vacuum in the condenser at low loads permitted maintenance of required jet velocity with decreased initial steam pressure. A device for automatically throttling steam supply as condenser pressure decreased was shown in the paper.

Cinder Elimination

A paper by N. S. Wade on the Pease Anthony Gas Scrubbers at the Kneeland St. heating plant was abstracted by Mr. Bower. Difficulty was reported in maintaining spray nozzles which are now made of lava and seem to withstand corrosion. Water to the scrubbers is recirculated, consequently becomes acid. Piping and pumps are rubber-lined to protect against its corrosive action.

Mr. Gavitt presented the paper by C. F. Dixon and F. P. Fairchild which described the dust-removal system installed in the Triangle Heating Plant, Washington, D. C. It is a 2-stage system comprising cinder catchers and electric precipitators in series. The precipitators are unusual in that gas passes through them vertically instead of horizontally and the passages are of iron plate instead of concrete. Gas passages between the collecting faces are 11¼ in. wide. The plates have louvre-like slots opening upward so that dust when dislodged will fall through the slots to a dead air space.

On test efficiencies at three different loads were 93.3, 94.8, 94.9%. At burning rates of 23-24 lb. of coal per sq.ft. of grate area the collected dust was light weighing about 7 lb. per cu.ft. At rates of 40 to 45 lb. dust weighed about 30 lb. per cu.ft. Power required was 6-8 kw. per boiler.

Methods of cinder elimination in some of the plants of the Philadelphia Electric Co. were described by John Dallas. Equipment varied from relatively simple trap arrangements to more complicated patented cinder eliminators. Test data was given showing collection efficiencies varying from 30 to 68% for the simple traps to 85 to 96.2% for the more recent collectors.

In discussion of the papers on cinder elimination, M. D. Engle briefly mentioned a centrifugal type cinder catcher that can be installed at the inlet to the induced-draft fan. G. K. Saurwein reported that at Harvard dust was conveyed by a screw conveyor with nozzles arranged to wet the dust just as it discharged to trucks.

Water Treatment

L. F. Collins presented the experience of the Detroit Edison Co. with zeolite-acid water treatment. Considerable data was given showing the effectiveness of this treatment in producing satisfactory feedwater and also data concerning difficulties. Considerable corrosion trouble is being experienced in the system up to the deaerating heater where boiler blowdown is introduced raising the pH value to 9.8.

Difficulty was experienced in keeping intact the gravel beds supporting the zeolite. Nozzles were developed that permitted the gravel to be eliminated and are in use in all but one of the softeners. It was subsequently learned that the movement of the gravel could be prevented by limiting flow to not over 2 g.p.m. per sq.ft. when filling a freshly drained softener. After the softener is filled, rates of 10 g.p.m. per sq.ft. can be used without movement of the gravel bed.

Apparently all commercial zeolites de-

teriorate. The amount lost annually varied from 2.8 to 4.4%. Period of satisfactory performance of green-sand zeolite was given as about 5 yr.

Data show zeolite treatment cost varying from 0.4 to 0.64 cents per 1,000 lb.

"Care and Treatment of Boilers When Laid Up for Extended Periods," by H. Farmer dealt largely with the use of sodium sulphite to absorb oxygen when the boiler laid up is not drained. The water must be alkaline as acid SO_2 is given off. The distribution Committee Report was presented by G. D. Winans and consisted of statements by operating companies on the following subjects: leak detectors, pipe weld reinforcements, waterproofing steam-main conduits, eliminating dirt from new pipelines, and absorbing expansion of pipe.

Following officers were elected for 1935: R. L. Fitzgerald, president; M. D. Engle, 1st v.-pres., J. R. McCausland, 3rd v.-pres.

A.S.H.V.E. MEETS IN TORONTO

A LARGE portion of those attending the semi-annual meeting of the American Society of Heating & Ventilating Engineers June 17-19 at Royal York Hotel, Toronto, Canada, were Canadian engineers.

Papers the first day had largely to do with classroom ventilation, and were not of great interest to power engineers.

Sunlight energy coming directly through windows constitutes a very considerable percentage of the air-conditioning load. Special heat-absorbing clear glasses, having high light transmission have been suggested for this purpose, and a paper describing the results of experiments using this type of glass was presented by W. W. Shaver.

Glass in these experiments was Borosilicate glass 3 mm. thick with a heat absorption of 53% and light transmission of 76%.

A reduction in cooling load varying from 9 to 28.5% was observed in the test house equipped with heat-absorbing glass as the outside window, with ordinary glass in the inside sash, and from 16 to 24% with single-heat absorbing glazing.

Heat needed in a 10-day winter test was approximately 9% more in a test house having double windows with heat-absorbing glass outside as compared with a similar house having ordinary glass outside.

To questions concerning the possibility of this glass losing its properties, the author replied that it seemed to have an indefinitely long life so far as they could tell.

Concerning relative costs, Mr. Shaver replied that the heat-absorbing glass costs about three times as much as ordinary plate glass.

C. P. Creighton described the air-conditioning installation at Molson's Brewery, Montreal, Canada. Air conditioning was installed in four fermenting rooms. Duct work where it passed over the fermenting tuns was somewhat unusual in that it was composed of two ½-in. layers of hard asbestos board, with ½ in. of wood fibre board between them. This was done to avoid contamination of the brew due to sweating on these ducts.

An all-electric heating, cooling and air-conditioning system which makes use of reverse refrigeration was described by P. Sporn and D. W. McLenegan. This system is installed in a 2-story and basement structure belonging to Atlantic City Electric Co. at Salem, N. J. Calculated heating requirements for a zero day were 285,000 B.t.u. per hr. Heat to be removed by air conditioning on a 95-deg. dry bulb and 75-deg. wet-bulb day is calculated as 108,000 B.t.u. per hr. During winter operation with reverse refrigeration, deep-well water is used as a source of heat, thus eliminating the decrease in capacity of refrigerating equipment that would occur on cold days if the heat source were outside atmosphere.

Tests were run on the system during February when the temperature dropped as low as 10 deg., and went as high as 55, giving an average of 34.5 deg. Total electric consumption was 9,475 kw.-hr. The performance ratio, including the power consumption of the deep-well pump under average temperature conditions, was 3.3.

Discussion brought out that the refrigerant was Freon, and that a very large amount of heat-transfer surfaces is needed in winter, due to the low temperature difference.

Authors believe that the heat pump can compete with a modern heating and air-conditioning system when the electric rate is somewhat less than $0.01 per kw.-hr.

A method for calculating air-conditioning load was presented by F. H. Faust, L. Levine and F. O. Urban. The paper summarized the factors which affect the cooling load and describes a systematic and rational method for determining its character and magnitude. A heat gain calculation sheet is presented which suitably organizes and tabulates the work.

No satisfactory method of measuring dust in the air has been standardized and accepted, and the performance to be expected of different types of filters are uncertain, due largely to the lack of standardized methods of measurement. Investigation of these factors was the subject of a paper by F. B. Rowley.

Improvements made to the viscous dust counter are described. The instrument in its present form has a 0.04-in. diameter orifice through ⅛-in. thick plate. The plate is placed 1/16 in. from a viscous-coated glass slide. The air sample is drawn through the orifice at 375 f.p.s., and for average laboratory air, good results can be obtained by moving the orifice over the surface of the glass plate at the rate of ¾ to ¼ in. per sec.

Having improved the dust counter, a comparison was made of results obtained when testing dust filters by the A.S.H.V.E. weight method and when using dust counters. This comparison showed for example, that a standard code test gave an efficiency of 72% for one filter when new, while the dust method gave an efficiency of 41.5%.

S. R. Lewis explained certified air conditioning and discussed standards used in Chicago. The standards for certified air conditioning were developed for the Chicago district by the consulting engineers division of the Western Society of Engineers, the Chicago Master Steam Fitters Association, and the Chicago Ventilating & Air Conditioning Contractors Association.

"Utility Capacity Ample"—Penn

NEARLY 5,000,000 kw. of surplus central-station generating capacity is now available in the United States, probably sufficient to take care of load growth up to the peak of 1938, according to Marion Penn, general manager Electric Dept., Public Service Gas & Electric Co. (N.J.) at the Atlantic City convention of Edison Electric Institute, June 3-6. Mr. Penn also pointed to steam and mercury "tops" on old plants as (in general) the quickest and best way to add capacity when eventually needed.

Defending the retention of 2,000,000 kw. of "obsolete" steam plant, criticized in governmental press releases, Mr. Penn stated that most of this is economically justified for peak load and standby use now and as a potential base for steam and mercury "tops" to be added when new capacity is needed.

If, said Mr. Penn, loads increase faster than he anticipates, manufacturers can supply 4,000,000 kw. of boilers and turbines yearly.

With 200- to 250-lb. plants he favored "tops" as an almost ideal way to add low-cost capacity and increase efficiency. Next best, in general, is the extension of old stations. Both methods avoid buying new real estate and utilize existing transmission facilities. Capacity of the high-pressure top may range from 60 to 100% of the low-pressure base turbine. Efficiency of the combined unit will fall only about 2% short of a completely new high-pressure plant.

Reviewing accomplishments and plans of Public Service Gas & Electric Co., Mr. Penn included:

1. Burlington plant's 18,000-kw. top on an old 200-lb. installation and plans for four 100,000-kw. condensing units.

2. Essex plant's conversion to oil-firing and plans for two 50,000-kw. high-pressure turbine tops, giving a combined heat rate of 11,300 B.t.u.

3. Kearny plant's 90,000-kw. turbine, addition of water walls and new superheaters to 12 boilers, and addition of a 20,000-kw. mercury-turbine top.

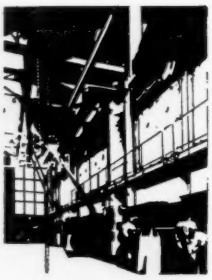
4. Marion plant's plan for a 50,000-kw. steam top on a group of three old low-pressure turbines.

5. Perth Amboy plant's present use for peak load and tentative plans for a 25,000-kw., 3,000-lb. pressure turbine top supplied by a Benson-type boiler with a resulting plant heat rate of 12,300 B.t.u.

In discussion, A.D. Bailey of Commonwealth Edison (Chicago) agreed with Mr. Penn as to the advantages of high-pressure tops for increasing capacity and efficiency simultaneously at low cost. A. H. Kehoe, New York Edison, agreed with Penn's statement of present excess capacity, but thought that load may catch up with capacity before 1938 with the aid of load-building plans now under way. F. S. Clark, Stone & Webster Engineering Corp., felt that new capacity may often be more economical than a top.

Critics of utility investment costs often overlook the requirements of high quality and dependable service, according to N. E. Funk, vice-president, Phila. Electric Co.

READERS' PROBLEMS



QUESTIONS for Our Readers

Standby Boiler Corrosion

Question 1

TWO *of our old Stirling boilers, kept as standby units, may go for several months without being used. Nevertheless, we feel it necessary to keep these units filled with water so they will be more readily available. We have found that the alkalinity of the water decreases in the top drum and increases in the mid drum. This action makes the water in the top drum more corrosive. Have any Power readers experienced this condition? If so, I would appreciate learning what they did about it.*—A.K.

Pipeline Drainage

Question 2

OUR *present boiler room at the north end of the manufacturing plant supplies saturated steam to a plant header which is sloped to drain at its far end. We are now building a new boiler house at the south end of the plant and will shut down the old boilers when it is finished. It is our intention to connect the new boilers to the plant header at its south end, but the question has been raised as to whether or not it will be necessary to regrade the header so it will drain in the direction of steam flow instead of against it when the new boilers go into operation. What troubles are likely to develop if the header is not changed, and can they be avoided without regrading (which will not be easy)?*

Suitable answers to these questions from readers will be paid for if space is available for their publication.

Engine Speed

OUR *plant contains a 6,500-sq.ft. boiler operated at 150% rating continuously for 8 hr. a day. Steam is supplied to a 650-kva. cross-compound Corliss engine generating 60-cycle, 3-phase power for our textile mill, to two 400-kva. compound engines, to process and to plant auxiliaries. We are unable to get the Corliss engine to run at high enough speed to generate at 60 cycles, 58 cycles being the best it will do. The design speed is 120 r.p.m., but 116 r.p.m. is obtained. This engine has been wrecked several times, and is about 30 years old. It has recently been rebored, lined up and two new valves fitted to the low-pressure cylinder. Steam is delivered from the boiler through an 8 in. lead feeding a 10-in. header. From the 10-in. line, branches feed the Corliss engine, the two small engines, process steam and auxiliaries. Is the trouble due to inadequate pipe size or is the low frequency due to incorrect valve setting? We have tried changing the setting of the stop pin on the flywheel-type governor with no effect. Working boiler pressure is 170 lb. and the tested engine gage shows 160 lb. at the throttle.*—L.W.R.

I note that the pressure drop between the boiler and engine is only 10 lb. This is ordinarily not excessive and would indicate your piping to be of ample size. An estimate of steam velocities indicates 2,000 f.p.m. in the 10-in. header and 4,500 f.p.m. in the 8-in. lead from the boiler. Both of these velocities are relatively low, good practice permitting velocities of 6,000 to 12,000 f.p.m. in steam lines.

In view of the fact that you have recently rebored your engine and reseated the valves it would seem that the trouble would likely be due either to improper valve setting or improper functioning of the governor.

You can check which by operating the engine at light or no load. If it comes up to speed at no load, look for improper valve setting. If the engine runs slow at light load, the difficulty is likely caused by the governor. To increase the speed setting of the governor it is necessary either to make the governor weights lighter or install an adjustable spring to oppose the action of the main governor spring.

Waxing Outside of Elevator Traveling Cables

I WOULD *like to know if the application of liquid floor-polishing wax to the external cotton covering of electric elevator traveling control cables would be detrimental to the insulation resistance of the cable for 220 volts. The object is to reduce wear on the external cotton covering of the cable*—H.G.B.

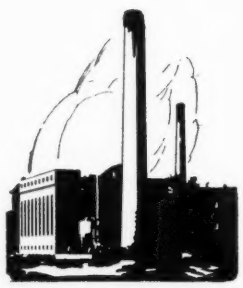
Use of this wax is not recommended, particularly since there are several others that would improve the insulation resistance of the cable. First, you might paint the cable with hot paraffine wax. Three types of waxes superior to paraffine are Cornauba, Montan and Candilla. The best of the three is Cornauba, and next is Montan. I believe you are having trouble with twisting of the traveling cables of your elevators. Traveling cables are now available that are designed and claimed to be absolutely neutral, and that will run free in the hoisting. It might be worth your while to look into their possibilities for your elevators.

PROTECTING AIR COMPRESSORS AGAINST EXPLOSIONS

ANSWERS to May Question 1

The Question

IN OUR *plant we have two 1,000-c.f.m. air compressors. I believe serious explosions have occurred in compressed-air receivers and other parts of the system. Our units have always operated satisfactorily, but as a safety precaution I would like to have the opinion of* POWER *readers on what causes compressed-air explosions and how to best guard against them so that I may carefully check up on operating conditions.* —C.A.A.



Gives Cause of Explosions and How to Prevent

COMPRESSED-AIR system explosions, while not generally considered common, happen often enough to warrant an investigation of the causes. I have checked up a number of compressed-air explosions and have always found they were caused by failure of a pipe or receiver, either due to weakening of the metal through internal or external corrosion, or by ignition of a mixture of combustible vapor and air in the receiver or pipeline.

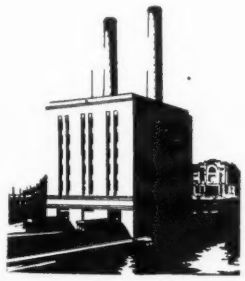
Failures due to the first cause can be easily controlled by periodic inspection of pipelines and receivers for any corrosion before it reaches dangerous proportions. Failures due to the second cause are generally the result of faulty operation causing an excessive temperature that will flash any combustible vapors present. Preventing formation of explosive vapors in excessive quantities and control of air temperatures will avoid these.

Combustible vapors frequently result from use of too much oil in the air cylinders. Excess oil passes through the discharge valves and collects in valve chambers, receiver and pipelines. Excess oil also combines with dust and dirt carried by the air and forms, what is commonly known as carbon deposits on the piston head, discharge valves and seats and in pipes between the cylinders and intercoolers. These deposits are capable of holding considerable quantities of gas which can be ignited by high temperatures or incandescent carbon particles carried in the air.

Lubricating oil used in air cylinders should be a high grade with a low carbon residue and a high flash point. Many ex-

plosions have been blamed on oil having too low a flash point. It will generally be found instead that a temperature was reached considerably above that at which even the best oil will flash. Oil flash point is therefore not held to be of as great importance as the carbon residue.

Excessive temperatures can be caused by any one or more of the following faults:



Inadequate supply of cooling water to cylinder jackets and intercoolers.

Using too high-temperature cooling water to permit proper transfer of heat from air to water.

Intercoolers and jackets blocked with dirt, mud and scale, preventing absorption of heat by the water.

Air baffles in intercoolers broken, permitting the air to short-circuit to the discharge with very little removal of heat.

Partitions in water heads of intercoolers not tight or broken, permitting the cooling water to short-circuit between the inlet and outlet connections without passing through the intercooler tubes.

Leaking valves or piston rings in the air cylinders, permitting re-entry of compressed air to the cylinders. Recompression of this air causes pyramiding of temperatures.

To prevent explosions, we have adopted in our plants the following operating rules and insist upon full compliance with them:

Use only high-grade compressor oil in the air cylinders.

Use the minimum amount of oil on which the compressor will operate satisfactorily.

Regulate oil feed to compressor speed.

Maintain air filters on air intakes in good condition to prevent dust and dirt entering air cylinders.

Clean intercoolers and jackets at regular intervals as per schedules set up for each individual installation, dictated by local water conditions.

Provide abundant cold circulating-water supply for intercoolers and jackets.

Maintain tight air baffles and water partitions in intercoolers.

Make periodic inspections of air valves, with regrinding or replacing of valves, springs, etc., as the type of compressor may require.

Periodically clean all air passages between cylinders and intercoolers and also piston heads and piston rings.

Maintain accuracy of intercooler gages so that abnormal intercooler pressures may be noted.

Closely watch interstage pressures and temperatures so that abnormal conditions may be promptly noted and corrected before pressures and temperatures become dangerous.

Blow off receivers each shift to remove oil that may carry over to them.

While the question submitted does not state the operating air pressure, these rules apply to any. We are using them for compressors ranging from 100 to 1,000 lb. discharge pressure. Watch the air leaving each intercooler to see that it is cooled down as close as possible to the initial air temperature entering the first stage. If this is accomplished, temperatures at the end of compression in the next stage will be safely below the flash point of any oil vapors or gasses that may be present unless valves or piston rings are leaking.

Pottsville, Pa. C. TYSON REILL

Nine Rules for Avoiding Explosions

COMPRESSED-AIR explosions are a real hazard, and are apt to occur in any plant where compressors are not given intelligent "prophylactic" treatment. I have seen a 10-in. underground air line explode and open up a trench 1,000 ft. long, 500 ft. of it under a concrete road. The violence of this explosion was unbelievable, the steel pipe being torn into small pieces.

To avoid such explosions it is only necessary to keep carbon deposits out of the compressor valves and air pockets, and oil out of the pipe line—explosions cannot occur where there is no fuel.

The following rules have been found effective in avoiding compressed-air explosions:

Provide a fusible plug set for about 400 deg. F. near compressor discharge valves.

Put a thermometer in the discharge pipe close to the compressor and watch it. Shut down the compressor if temperatures rise above 350 deg. F.

Install an aftercooler as close as possible to compressor.

Use proper grade of lubricating oil and in minimum quantities.

Keep air receivers and drip-tanks drained.

Examine air line for pockets, and keep them drained.

Examine compressors internally periodically and at that time remove any carbon deposits.

See that air filters on the intake are kept in good order.

Feed into the compressor while running a few gallons of a solution of castile soap and water after every 150 to 200 hr. of operation.

The above rules apply to 2-stage intercooled compressors. Single-stage compressors for pressures of 100 lb. per sq.in. are dangerous.

Philadelphia, Pa. A. S. WOODLE, JR.
Plant Engineer,
Baldwin Locomotive Works

Most Explosions Occur When Compressor Operates Unloaded

COMPRESSED-AIR explosions are really oil-vapor explosions. They generally start at the compressor, and travel through the receiver some distance along the pipeline. They may do considerable damage to piping at points where there are sudden changes of direction, to safety valves, compressor valves, air-meter orifices and other parts of the metering system.

With reciprocating compressors, the standard pressure of compressed-air supply is about 100 lb. per sq.in. Generally 2-stage machines are used for this pressure, with an intercooler between the cylinders that reduces second-stage inlet air temperature to near that of atmosphere. Second-stage-cylinder compression raises air temperature to 200 to 250 deg. F., depending on water-jacket efficiency and air friction. Lubricating-oil vapor ignites at about 400 to 500 deg. F. The temperature of compressed air is therefore well below the oil-vapor ignition point. Consequently, an explosion cannot occur unless oil-vapor temperature is raised or its flash point lowered.

The latter sometimes occurs when kerosene or other liquid with a low flash point is used to clean cylinders or valves of the compressor. Leaky discharge valves which wire draw the air and cause intense local heating are a common cause of explosions. During normal compressor operation the comparatively cool air passing through the machine will render these hot spots harmless. It is when compressors are running unloaded that explosions are most likely to occur.

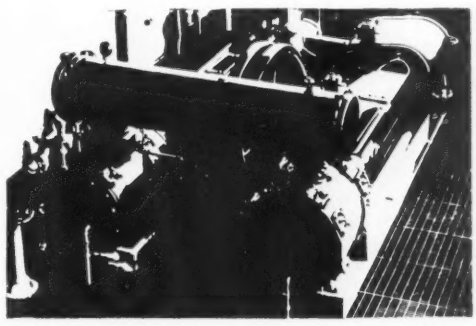
Wire-drawing of air through a small leak heats both the air and the valve. This heating is cumulative, and eventually a temperature is reached that will explode the mixture of oil vapor and air immediately surrounding the valve. It takes time to reach the explosion point, and explosions rarely occur unless a compressor has been running unloaded for 15 min. or more, therefore never run a machine unloaded for a long time and be sure cooling-water service is adequate and uninterrupted.

Noranda, Que. E. SCOTT RIVETT

Uses Fusible Plugs for Protection

IT IS my opinion that an explosion always starts at the compressor, due to a leaking or broken valve, heating the air above the flash temperature of the oil. Failure of jacket water can also cause overheating of the air, but will probably attract attention before the firing point is reached.

Flame or bits of glowing carbon are carried to the receiver, where there may be an explosive mixture of oil vapor and air. The flame may also be carried to the receiver by surface combustion of oil on the inside of the discharge pipe. To prevent a possible explosion, I have always kept the valves in good condition, the receiver clean and well drained and used just enough good-grade oil for proper lubrication. I remove carbon at regular intervals with soapy water (this can be done with the compressor in operation). I



never allow kerosene around a compressor even when it is cold.

Install in the discharge line close to the cylinder as many boiler fusible plugs as needed to discharge more air than the machine can supply. My theory is that the plugs will blow before the air temperature reaches the firing point, the rush of air will tend to keep flame or burning carbon away from the receiver, and the falling pressure will have a cooling effect on the air. I have used fusible plugs for more than 20 yr. and never had one blow, but I consider them good insurance.

Chicago, Ill. C. G. HARDEN

Specifies Amount of Lubricant to Use

EXPLOSIONS in compressed-air systems can be prevented by using the least quantity of good quality oil that will lubricate pistons and valves, supplying sufficient jacket and intercooler water and taking air from a clean location and through modern intake filters. For cylinder lubrication, mechanical lubricators are recommended, and the oil should be of heavy medium viscosity for usual temperatures, with a high flash point. The least quantity of oil that will leave a light film on the discharge valves will provide sufficient lubrication, about 4 to 6 drops a minute for a 1,000-cu.ft. compressor.

Cylinder jackets and intercooler tubes should be kept clean. When they become scaled, the scale should be removed with a solution of inhibited muriatic acid. The required volume of cooling water for various inlet temperatures can usually be recommended by the compressor manufacturer. Additional protection against explosions can be obtained by installing an aftercooler between the compressor and receiver.

Watertown, Mass. R. WILLIAMSON

Compressed-Air Society Recommendations

IT WAS formerly thought that most compressor explosions were traceable to the flash point of cylinder oils. Contrary to this, it is now known that the flash point is relatively of no importance, insofar as explosions are concerned.

Trade standards adopted by the Compressed Air Society, New York, N. Y., as well as literature supplied by various compressor manufacturers state that the few air compressor explosions that have taken place might have been prevented by following the rules given below:

1. Proper installation.
2. Proper cleaning and maintenance.
3. Use of the correct oil.
4. Use of the correct amount of oil.
5. Maintaining proper cooling-water circulation.
6. Operation of the compressor in the service for which it was designed.

Augusta, Ga. R. C. BAKER

SHOULD SHOULDERS BE PUT ON WRISTPINS

ANSWERS to May Question 2

The Question

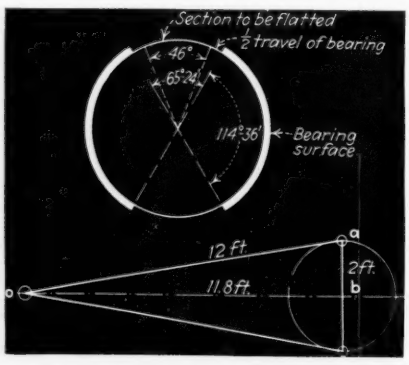
I HAVE *noticed that wristpins of our steam engines are eventually worn flat on the two portions of their circumference that take thrust. This creates shoulders at top and bottom and interferes with operation. I have been told this can be prevented by machining flats on the non-thrust portions of the journal. Before doing this, I would like to know if it is practical. If it is, where should the flats be located, and how much area should they cover? Or is it better to turn the pin, or to machine it undersize and fit new bearing shells?*—R.K.

How to Figure Amount of Flat

IT WAS formerly not uncommon practice for engine builders to provide means of turning the wristpin one-quarter turn so that shoulders might be eliminated. But the smoothest-operating wristpin is one flatted to allow the bearing to ride over the point where a shoulder might be worn. The following example is given to show just how much the wristpin should be flatted to allow the box to pass over the point of contact.

Consider a 5-in. wristpin. The bearing surface of the box is taken as 5 in. and, therefore: the angle formed will be approximately $\frac{5}{5 \times 3.1416} \times 360 = 114$ deg. 36 min. To find the angle of throw of the wristpin box, the right-angle triangle ABO is used; the connecting rod being six times the throw of the crank, the sides of the triangle are 12, 11.8 and 2 ft. The angle may be obtained as follows: $\frac{2}{11.8} \times 57.29^* = 9.7$ deg. or 9 deg. 42 min.

The angle subtended by the flatted surface is 65 deg. 24 min. minus 2 × 9 deg. 42 min. or 46 deg. On the 5-in. pin in question, the width of the flatted portion will be $\frac{46}{57.29} \times 2.5 = 2.01$ in. For high-speed engines where the relation of connecting rod and throw of crank is much less than six to one the flat can be much less.



New York, N. Y. C. W. PETERS

*Angle subtended by one radian is 57.29 deg.

Flat Spot Not Correct

I DO not believe machining flat spots at the top and bottom of the pin would be correct. To make flat spots avoid the shoulders mentioned, it would be necessary to make them overlap and thereby reduce the bearing area of the pin.

If the engine was extremely long and connected so that the connecting-rod angle was small, it might be all right to turn the wrist pin 90 deg. but in an engine of average design this would also decrease the bearing surface.

It would probably be less expensive to provide a new pin to which the old boxes might be fitted than to turn down the pin and provide new boxes, and it would have the added advantage of maximum bearing surface.

After any of these methods of repair have been put into practice, it would be advisable to run the bearing with the smallest amount of clearance possible. This will probably result in much longer life than formerly.

Lansing, Mich. C. E. BARRY
Olds Motor Wks.

Don't Machine Pin Use a New One

THE practice of flattening the top side of the wristpin is almost as old as the steam engine. Some engineers and engine repair men flatten both top and bottom. It is rare that flattening the bottom is necessary when wristpoin boxes have proper clearance away from the pin where the edges almost meet at the top and bottom of the pin. Each half of the bearing should have a clearance of at least $\frac{1}{32}$ in. top and bottom to prevent pinching and at the same time lessen the possibility of a shoulder. How far back you start to scrape to get this clearance depends on the size of the bearing and pin. Many engines are built so that the wristpin can be given a quarter turn. This feature eliminates the possibility of flattening. In this case, when the pin is given a quarter turn it is generally necessary to stone the pin slightly.

Rather than machine the pin and fit new boxes I would much prefer to get a new pin and use the old boxes if they still had enough metal in them. This keeps the part standard.

You need have no concern over the practice of flattening the top and bottom of all your wristpins, and the area can be all of what is termed the none-thrust portion. This will naturally depend on the stroke of the engine. For example a 3-in. diameter pin on a 42-in. stroke engine would have a flat about 1 in. wide the entire length of the working part of the pin. My suggestion would be try the flattening on your worst pin, and when you arrive at the right amount on that pin, guide yourself accordingly on the others. In this way you will learn more than in any other way. When I speak of flattening the top and bottom of the pin I refer to horizontal engines. In vertical engines the sides of the pin would have to be flattened.

Dorchester, Mass. WM. F. O'REGAN

THE ENGINEER'S BOOKSHELF

Water Purification

ELIMINATION OF TASTE AND ODOR IN WATER (1935)—*By John R. Baylis, physical chemist, Division of Water Purification, Bureau of Engineering, Dept. of Public Works, Chicago, Ill. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. Cloth. 392 pages, 6x9 in. 88 tables; 85 illustrations. Price $5.*

This book is one of a series of engineering monographs being sponsored by the A.S.C.E., A.I.M.E., A.S.M.E. and A.I.E.E. Much of the information on treatment of water to remove objectionable tastes and odors, scattered through the technical literature, has been brought together in this book, along with data not heretofore published. The many sources from which the information has been collected are given and form a valuable part of the work.

Chapter One deals with taste and odors, their characteristics and the methods of evaluating them. Eight chapters, 209 pages, are given over to activated carbon, which is being used extensively for removing objectionable tastes and odors and, in many instances, is the only known means of producing palatable water. Ammonia-chlorine treatment occupies four chapters, aeration and ozone-potassium-permanganate bleaching clays are each the subject of a chapter.

The material is presented in readable form, so that the book will be valuable to all those interested in water problems, be they chemists or engineers.

Diesels

DIESEL AND OTHER INTERNAL-COMBUSTION ENGINES (SECOND EDITION, 1935). *By Prof. Howard E. Degler, M.E., chairman, Dept. of Mech. Engrg., Univ. of Texas. Published by American Technical Society, Chicago, Ill. Cloth. 237 pages, 5½ x 8¼ in. 100 illustrations. Price not given.*

This is a general text on internal-combustion engines, with title revised and material on diesels added to bring it up to date. About 115 pages are strictly on diesels, plus 23 pages on the Packard aircraft diesel. Also includes simple basic thermodynamics, data on fuel and fuel-air mixtures, engine details, testing methods, economics of diesel power, etc.

Elevators

ELECTRIC ELEVATORS (SECOND EDITION, 1935). *By F. A. Annett, Associate Editor, POWER. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. Cloth, 495 pages, 6x9 in., 346 illustrations. Price $5.*

When making his revision the author did very little rehashing of the material in the first edition, but eliminated eight of the least important chapters in the old edition and replaced them with about 200 pages of new material. The old edition had 448 pages, the new 495. Chapter I has been greatly enlarged with material on electron-tube leveling control, automatic-landing equipment, automatic inductor-type control, preregister control, automatic-landing pushbutton control.

Complete chapters have been added on double-deck cars and two cars in one hoistway; A. B. See car-switch control with automatic landing; Otis unit-multi-voltage signal control with micro-leveling; elevator-door operating equipment; signal systems; ropes, their construction, inspection and care; and selecting elevators for office buildings. The chapter on lubrication has been enlarged to include a description of the various types of automatic guide-rail lubricators and guide-shoe gibs.

Power Rates

FEDERAL POWER COMMISSION ELECTRIC RATE SURVEY (PRELIMINARY REPORT)—*Domestic and Residential Rates in Effect Jan. 1, 1935. Cities of 50,000 population and over—Rate Series No. 1. Paper, 9x12 in., 33 pages of text, tables and charts. Supt. of Documents, Washington, D. C. Price 10 cents.*

This report, almost entirely factual in character and based on a nation-wide survey, covers all cities (192) in the U. S. with a population of 50,000 or over, for both municipal and privately owned utilities. Rates are presented in the form of the total monthly bill of a domestic consumer using 15, 25, 40, 100, 250 and 500 kw.-hr., respectively, under specified typical conditions.

For a 100 kw.-hr. consumption in cities above 100,000 population, the monthly bill ranges from $2.12 in Tacoma, Wash., to $7.00 in Jacksonville, Fla. The corresponding range for cities between 50,000 and 100,000 is from $2.73 for Madison, Wis., to $7.31 for New Rochelle, N. Y. Differences are still more striking on the consumption levels of 250 kw.-hr. and 500 kw.-hr.

Only the extremes are cited here. The complete and carefully authenticated data presented in the tables and charts should be of value to all interested in the rate problem from any angle.

Brief Reviews

DISSOLVED OXYGEN IN BOILER FEEDWATER (1935). *By M. C. Schwartz, Ph. D., boiler feedwater fellow, La. Steam Generating Corp. Paper. 46 pages, 6x9 in. Published by the Library, La. State University Press, Baton Rouge, La. Price 50 cents.*—In two sections, Section I "The Determination of Dissolved Oxygen," Section II "A Selected Bibliography on the Determination of Dissolved Oxygen in Water."

ELECTRIC LIGHT & POWER INDUSTRY IN 1934. STATISTICAL BULLETIN NO. 2, APRIL, 1935. *37 pages, 9x12 in. Publication C1 of Edison Electric Institute, 420 Lexington Ave., New York, N. Y. Price 30 cents to members, 75 cents to non-members*—Complete data on the industry.

CITY OF HOLLAND, MICH., 41ST ANNUAL REPORT *(1934)*—Includes elaborate statistics and cost analysis for generation and distribution of electricity from the municipal steam plant.

JAHR BUCH DER VERKEHRSDIREKTION (1934)—Annual report of the Berline Electric Works, Berlin, Germany.

ENGINEER'S HAND BOOK, A PRACTICAL MANUAL GIVING RECOMMENDED TYPES, SPECIFICATIONS AND APPLICATIONS OF PISTON RINGS *(3rd Edition, 1935). Published by American Hammered Piston Ring Co., Baltimore, Md. Cloth. 156 pages, 5 x 7½. Free.*—While this is a manufacturer's catalog, it is sufficiently elaborate and includes enough engineering data to be a worthy addition to any engineer's library. For data on types, applications, design, fitting, and so on, this is the book.

STEAM AND ELECTRICAL REQUIREMENTS OF OFFICE BUILDINGS (1935). *A report of the Sales Committee, Edison Electric Institute, 420 Lexington Ave., New York, N. Y. Publication C2, 14 pages, 9x12 in. Price 30 cents to members, 75 cents to non-members*—Provides a group of basic factors for determination of approximate steam and electrical requirements. Gives tables of unit consumption from tests and operating data on many buildings in large cities, also curves.

CONTRIBUTIONS TO THE STUDY OF COAL. *(Report of Investigations No. 35, Illinois State Geological Survey, Urbana, Ill.). Price $0.25 to non-residents of Ill., $0.05 to residents*—Includes "Influence of Structural Irregularities. Upon the Chemical Character of No. 6 Coal in Franklin and Williamson Counties," by E. T. Benson and G. H. Cady, and "Distribution of Sulphur in Illinois Coals and its Geological Implications," by G. H. Cady.

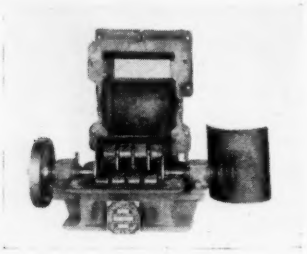
SELECTION AND REPLACEMENT OF MANUFACTURING EQUIPMENT—*A Discussion of Economic Factors. By Paul T. Norton, Jr., prof. indus. engrg., Va. Polytechnic Institute, Blacksburg, Va. Published as Bulletin No. 11, (Part 1) of Vol. XXVII of the Institute*—Data on obsolescence and depreciation.

FOREIGN BODIES IN OIL. *Technical bulletin No. 40.1 of Acheson Colloids Corp., Port Huron, Mich. 3 pages. Free*—Deals with crankcase analyses and deductions on sludge.

FUEL OILS *(3rd Edition). Commercial Standard CS12-35 of U. S. Dept. of Commerce, 14 pages, 6x9 in. For sale by Supt. of Documents, Washington, D. C., 5 cents*—Includes specifications for six grades of fuel oil, identical with ASTM Tentative Specifications of Fuel Oils D396-34T, for various types of fuel-oil burning equipment.

MCGRAW-HILL BOOKS (1935). *Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. 242 pages, 6x9 in. Free*—Regular annual catalog of technical and scientific books, including semi-technical publications of Whittlesey House.

WHAT'S NEW IN PLANT EQUIPMENT



LABORATORY COAL CRUSHER

COMPACT and simple design with all parts of housing machined to insure dust-tight fit. Heavy construction with housings reinforced with ribs where crushing strains are greatest. Bearing pedestals cast integral with lower housing. Split housing for accessibility and easy cleaning. Frame high-test gray iron, or can be furnished in cast alloy or stainless steel. Rotor or cylinder consists of heavy main shaft of alloy steel, cast steel end disks and manganese steel rings or hammers. Sometimes center disks are used and number of rows and kind of rings or hammers depends upon application. Main shaft rotates on SKF ball bearings mounted in dust-tight self-aligning pillow blocks bolted to pedestals of lower housing. Screen plate slides in grooves in lower side housing. Opening depends upon application and regulates fineness of ground product. Practically all grinding is done on breaker and grinding plates in front of grinding chamber, which can be easily and quickly renewed. Round back of upper frame protected by renewable liner. Two sizes, 9x9 and 15x9, first taking 1 to 5 hp.; second, 5 to 10. Illustrated is 9x9 ring mill open for inspection. Can be furnished as shown in photo or mounted on stand or direct motor drive on cast-iron base.

American Pulverizer Co., 1209 Macklind Ave., St. Louis, Mo.

FLOW REGULATING VALVE

"FLOCONTROL" valve has special slotted teeth so that flow through valve is always directly proportional to number of turns of handwheel, thus user can get straight-line control. With micrometer adjustment, valve can be regulated to within one-tenth turn, every increment of valve opening varying flow in proportion; that is, if valve is set at two turns open, then twice as much steam or liquid will pass through it as when it is set at one turn. May be used for steam, oil, water or gas, has bronze body for pressures to 300 lb. in globe (Type 4515) or angle (Type 4535) types. Sizes $\frac{3}{8}$ to 2-in.

Hancock Valve Division, Consolidated Ashcroft Hancock Co., Inc., Bridgeport, Conn.

CEMENT INSULATING MATERIAL

"PORETHERM" heat-insulating material is made of Portland cement with or without mineralized wood fibre. Usually made in two weights, 19 and 32 lb. per cu.ft. Can be made in precast shapes in form of slabs and blocks of various sizes, or poured in field under normal circumstances. No. 19 is used for refrigerating and cold storage at temperatures up to 700 deg. on steam pipes, etc. No. 32 is an insulating fill for floors, roofs and ceilings. Has crushing strength to 150 or 200 lb. per sq.in. Material is permanent and fireproof, does not deteriorate or spoil when exposed to moisture, odorless, vermin-proof and fungi-proof.

Porete Mfg. Co., Porete Ave., North Arlington, N. J.

ISOMETRIC LINE SKETCH PAPER

FOR quick, easy sketching of three-dimension drawings, all axes spaced 1-in. and subdivided $\frac{1}{4}$ in. Double line "Y" shows center and isometric principle at a glance. Guide lines in green. Only close dimensions need be noted, as all lines are to scale. Two sizes, 8x13-in., and 4x6$\frac{1}{2}$-in., pocket size, larger in 40-sheet pads, smaller in 100-sheet pads with holes marked for engineer's pocket books.

Wade Instrument Co., 2274 Brooklyn Station, Cleveland, Ohio.

VARIABLE-SPEED TRANSMISSION

THIS hydraulic unit gives an infinite variety of variable speeds accurately controlled, anywhere between 5 and 750 r.p.m. Proper speeds secured instantly and smoothly by turning handwheel which varies stroke and delivery of multiple-piston pump. Additional adjustment permits speeds up to 2,500 r.p.m. Hydraulic, mechanical, or electrical remote control can be substituted for manual control if desired. Minimum torque required; no V-belts, pulleys or speed reducers. Both ends can be provided for rotation in either direction, and can be changed on job without difficulty or additional parts. Units also available with mechanism for instantaneous change of direction. Capacity up to 6 hp. continuous duty at 1,000 lb. per sq.in., and 7$\frac{1}{2}$-hp. intermittent service at 1,250 lb. per sq.in. Larger units later. Safety valve set at 1,500 lb. per sq.in. No exposed working parts or piping. All working parts self-lubricated. Drive by direct-connected 1,200-r.p.m. motor. Unit at left has flange mounted motor direct-connected to pump shaft. Bulletin 35-T8.

Vickers Incorporated, 1400 Oakman Blvd., Detroit, Mich.

DIFFERENTIAL INDICATING PRESSURE GAGE

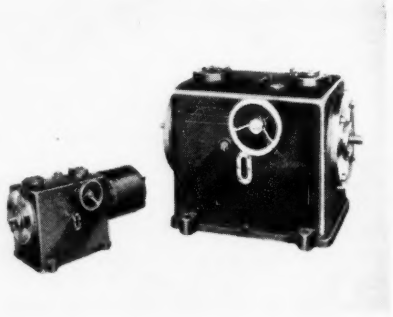
CONTAINS two sensitive actuating elements (bourdon tube or bellows) and simple rugged linkage arranged to indicate automatically with one pointer difference between two line pressures acting on gage mechanism simultaneously. Avoids necessity for two gages. Gage can be supplied in dial sizes 3$\frac{1}{2}$ in. in diameter and up, and so arranged that indication will show which line pressure is higher or lower.

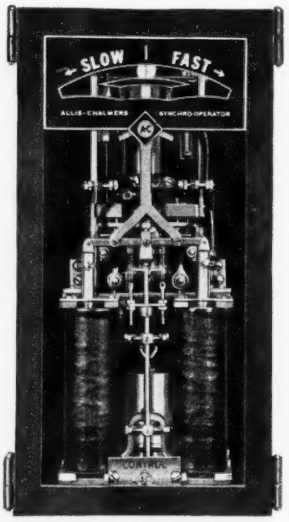
United States Gauge Co., 44 Beaver St., New York, N. Y.

COLORED VALVE WHEEL

MOLDED colored plastic materials are used in valve wheels to designate valves for steam, water, air or any other fluids and gases by distinctive colors. Five standard colors: blue, red, black, green and gray, unmarked or with five standard service markings molded in relief. Also special colors or special markings if required. Wheels strong, cool to touch and easy to grasp, as well as permanent in color.

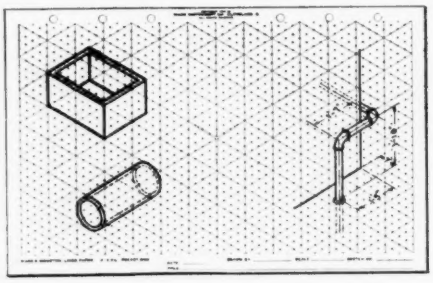
Jenkins Bros., 80 White St., New York, N. Y.

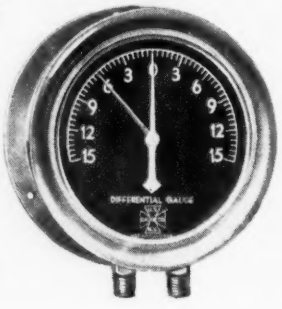




SYNCHRONIZING DEVICE

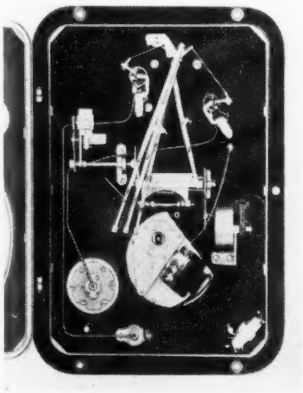
"SYNCHRO-OPERATOR" automatic control device eliminates human elements and combines speed matching, synchronizing and visual phase-angle indicating, formerly requiring frequency matcher, automatic synchronizer and syn-





chroscope. Unit not much larger than usual synchroscope, can be mounted on swinging bracket. Will synchronize generator and bus even if there is a voltage difference. Satisfactory for both stable and erratic frequency. Control closing instant advanced to compensate for inherent time lag in circuit breaker, thus making breaker close at exact point of synchronism. One operator will serve any number of generators and can be used in connection with existing governor control motors and station circuit breakers. Operates through standard potential transformer metering circuit.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.



MECHANICAL FLOW METER

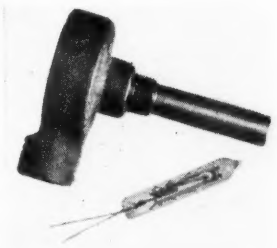
UTILIZING orifice and mercury manometer system of flow measurement, meter is designed to give precision measurement under severe field conditions. Meter body is forged steel. Uniform areas of cross-section in mercury chambers contribute to accuracy and interchangeability. Small changes in mercury volume incidental to capillarity and adhesion do not affect accuracy. Long float lever arm connecting large float to pen arm for hair-line sensitivity, without jumping and for sustained accuracy. Connections are welded or mechanical. All parts counter-balanced. Working parts can be cleaned without disturbing calibration. Stainless steel stuffing box lapped to shaft. Grease-packed for leak-proofing. No glands or packing washers. Ranges are obtained by changing orifice size, or high-pressure leg of manometer, or both. Integrator positive in action, and avoids need for friction contacts and friction clutches. Check valves, operating by gravity, prevent mercury loss. Meters for working pressures of 1,000 lb. are tested at 2,000 lb. Special bodies tested at 5,000 lb., are obtainable for working pressures up to 3,000 lb. Meters available for indicators, integrators, recorders or controllers. Recorders with pressure and temperature elements, if desired. Integrating flowmeters obtainable either with or without compensation for fluctuations in static line pressure. Suitable for use with either orifice plates or Venturi tubes. Can be arranged for electric flowmeter for remote reading.

Bristol Co., Waterbury, Conn.

IMPROVED FIRE HOSE

"WHITE ANCHOR" bias-laid fire hose remains straight when pressure is applied, thus minimizing danger of "wild" hose in emergency and simplifying rewinding after use. Obtained by new method of laying fabric in wrapped hose to eliminate twist under pressure. Invented and patented by A. D. Maclachlan of Technical Staff:

B. F. Goodrich Co., Akron.



TEMPERATURE CONTROL FOR INTERNAL-COMBUSTION ENGINES

FOR use on water-cooled internal-combustion engines, this temperature control forms nucleus for automatic engine protection. Control sealed in glass tube, inclosing an inert gas to avoid pitting or oxidation of contact points. Loss of calibration due to continuous operation or tempering is impossible. Control is mounted in a metal tube provided with standard pipe threads and suitable junction box for electrical connections. Unit may be mounted in diesel cooling water line to signal attendant when predetermined temperature is reached, to stop engine when temperature approaches dangerous degree, or to hold water temperature constant by varying flow. In gas engines it may vary water flow or cut off ignition by opening primary of ignition coil or grounding out magneto. Also used on supervised gas engines to sound alarm. Known as Catalog M6-D8.

Edison Electrical Controls Division, Thomas A. Edison, Inc., West Orange, N. J.

TUBING CUTTER

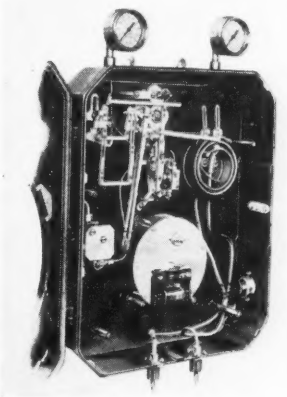
"RIDGID" tubing combines light weight and strength. Made for $\frac{1}{2}$ to 1-in. tubing, and weighs but $6\frac{1}{2}$ oz. Is $5\frac{1}{2}$ in. long when set for $\frac{1}{4}$-in. tubing. Right-angle cuts obtained by having cutting wheel and V-pad always at center of tubing, and solid screw saddle moving in straight line.

Ridge Tool Co., Elyria, Ohio.

RESET CONTROLLER

AN OUTGROWTH of so-called "differential controllers" used chiefly in air conditioning. Unit incorporated Taylor "Fulscope" control mechanism and is easily adjusted to meet a great variety of requirements. Will control temperature, pressure, rate of flow or liquid level in a predetermined relation to some other temperature, pressure, rate of flow or liquid level. Can be used on all applications where a fixed differential must be maintained between two variables, one under control, or where control of a process must be changed in accordance with predetermined ratio to a secondary process or condition. Records both adjusting and control conditions. Maximum ration between is 5 to 1, which means that control points can be shifted a maximum of five units for each unit change in resetting system. Both direct and inverse ratio adjustments are possible. Direct ratio adjustments cause an increase in control condition when adjusting condition increases. Inverse ratio adjustment causes increase in control condition when adjusting condition decreases, thus unit may be used for maintaining pressure in a tank, at a constant differential above pressure in pipeline, or, in feedwater heaters, in air-conditioning, etc. Unit may be mercury vapor or gas-actuated for temperature applications. Control is maintained by regulating flow of air pressure to diaphragm valve in controlling medium line. Die-cast aluminum case for face or flush mounting.

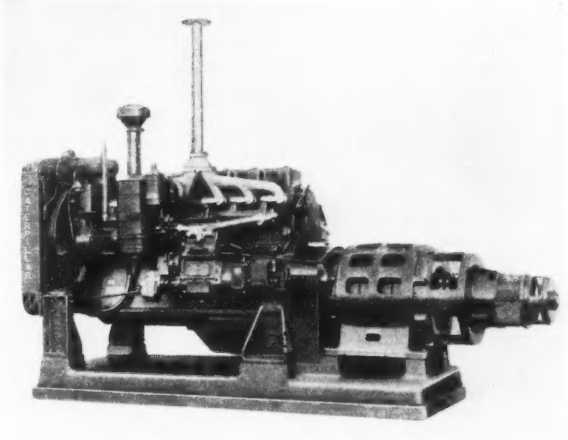
Taylor Instrument Companies, Rochester, N. Y.

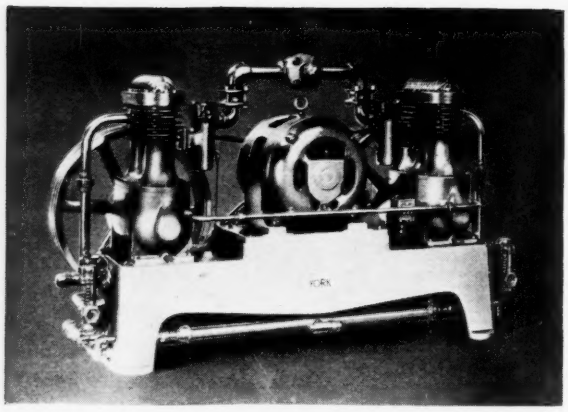


DIESEL-GENERATOR SET

"HARNISCHFEGER - CATERPILLAR" diesel-generator sets are available in capacities from 35 to 60 kw. for a.c. or d.c. Generators are single-bearing type, direct-connected by link coupling to diesel and mounted on heavy cast-iron base. Illustrated is 50-kw. alternator with mounted exciter. Standard unit includes engine with all auxiliaries, radiator cooling system, starting engine, auxiliary fuel pump, engine controls to provide proper speed setting and close governing, coupling between engine and generator, flywheel and coupling guard and generator mounted on unit base. Built cooperatively by Harnischfeger Corp., Milwaukee, and:

Caterpillar Tractor Co., Peoria, Ill.





CONDENSER UNIT

FREON "Balanseal" condensing units have been extended from 7½ to 25 hp., giving 18 machines in series. Also three new horizontal-type air conditioners in capacities up to 30 tons of refrigeration are being introduced. New units are complete with motor, compressor, receiver and automatic controls, all on one base. Model 44T6FW is new 10-hp. single compressor, while other new models are duplex units with motor mounted in center of base and belted to identical compressors in each end. Model 446FWD, 15-hp. unit, is a duplex, with two, 2-cyl. compressors. 20 and 25-hp. units, models 44T6FWD and 44T8FWD have two 3-cyl. compressors. For use with Freon, these units have all features of smaller units, including Pressureflex suction and discharge valves, Centriforce oiler, air-cooled cylinders, and electric furnace nickel iron cylinders, crankcase and pistons. Standardized compressor parts to keep down production cost and permit part interchange. Standard equipment includes ample size water-valve, V-belt, belt adjustment, high-pressure cutout, low-pressure control, liquid line strainer, and suction strainer. Illustrated is 20-hp. duplex unit.

York Ice Machinery Corp., York, Pa.

LIGHT WEIGHT REFRACTORY CONCRETE

"FIRECRETE" for casting lightweight refractory concrete on the job is composed chiefly of high alumina clay calcined at high temperatures. Resulting concrete weighs only 75 lb. per cu.ft., and has negligible shrinkage under continuous operation at 2,400 deg. F. Withstands severe alternate heating and cooling without spalling. 40% lighter than fire brick and 40% lower in heat storage capacity. Reduced radiation losses. Recommended for light weight refractory shapes and furnace doors and floors.

Requires only 12 to 24 hr. air-curing.

Johns-Manville, 22 East 40th St., New York, N. Y.

HORIZONTAL EDGEWISE PYROMETER

"ALNOR" horizontal edgewise pyrometer is furnished with or without multi-point switch, as desired. With switch, can be obtained either with 8, 17, 18 or 25-points. Damper for moving elements to avoid overswing or oscillation, full 6-in. scale for accuracy in reading, waterproof indicator case, which is also fume and dust-tight. Cold end adjusting screw manually operated; automatic internal cold end compensator at slight additional cost. Size, 7½x10¼x7 in. deep. One thermocouple is used for each zone at which a temperature reading is required, thus in the diesel one thermocouple is used for each cylinder or exhaust chamber. Double-switch arrangement available to accommodate up to 48 cyl. if desired.

Standard ranges available of 0 to 1,000 up to 0 to 3,000 in six sizes for each number of circuits. Lower ranges to as low as 0 to 300 deg. F., if desired.

Illinois Testing Laboratories, Inc., 141 W. Austin Ave., Chicago, Ill.

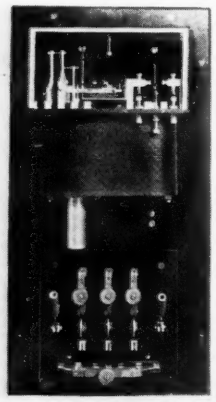
NATURAL ZEOLITE

"HI-INVERSAND" natural zeolite has high exchange for water-softening. Combined high exchange value of synthetic zeolite with durability of greensand. Manufacturer claims that with 1½ lb. of salt from 4,000 to 4,200 grains of hardness can be removed. Equivalent to 0.37 lb. of salt per kilograin of hardness removed. Can be used in open-type gravity softeners, or in pressure type. Also sold under name "Hi-Basex" when used in other than Inversand water softener.

Hungerford & Terry, Inc., Clayton, N. J.

VOLTAGE REGULATOR

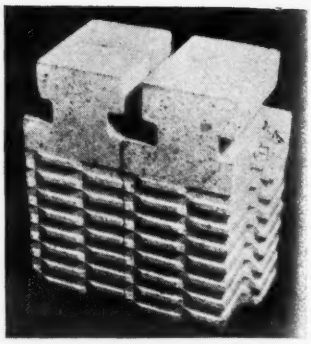
THIS vibrating-contact type unit is for maintenance of close voltage regulation in a.c. generator installations. Simplified construction. No dashpots or other damping or retarding devices. Main coil actuated by a.c. only. Main contacts platinum and iridium, and relay contacts tungsten or silver. Can be arranged for operation with one or more generators operating separately or in parallel. Regulator suitable for use with units of capacities from 1 to 5,000 kw.



Simplex Corp., Burlington, Iowa.

SUSPENDED REFRACTORY ARCHES AND WALLS

ABOUT half the size of T-slotted tile, and with corrugated or treaded faces which match together with adjacent tile, these new refractories to support suspended arch and wall construction have corrugations so designed that longitudinal joints in an arch, and vertical joints in a wall, can be either straight line or offset. Smaller tile is claimed to reduce spalling by providing better molding and more uniform burn to tile interior and by holding spalls in individual tile in place by corrugations on adjoining tile. Intermeshed faces eliminate working through of furnace gases or flames, and prevent air from leaking into furnace. Instead of usual flat sheet of fire clay or joint material, used in arch or wall joints, this construction has a joint in form of a waffle. Joint material is so locked that it cannot become loose or fall out, thus providing an expansion cushion and preventing leakage. Staggered joints in arch and wall prevent possibility of molten slag running along joint and cutting it out. Smaller tiles are easier to handle and speed up installation and repair. Called "Detred," and designed to fit existing installations of Detrick Co. without changing iron parts. Bulletin.



M. H. Detrick Co., 140 S. Dearborn St., Chicago, Ill.

RUBBER PROTECTIVE COATING

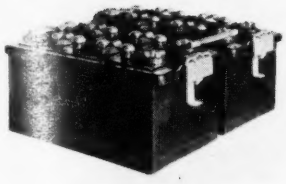
"KELSANITE" rubber protective coating can be applied in liquid form by spraying. Used to prevent rust in storing metal parts, for absorbing dirt or moisture on surface being coated, and as a masking compound for plating or metal spraying.

Kelsan Products, St. Clair, Mich.

SPIRAL LEATHER PACKING

SPIRAL leather packing, in 100-ft. coils, in ½-in. and ¾-in. widths in five diameters from 6 to 16 in. Can be wound on rams of any size between these diameters and larger. Rings of any desired length can be cut for insertion in a stuffing box in the usual staggered fashion. Material is "Thermo" leather, claimed not to swell or shrink.

C. W. Marsh Co., Muskegon, Mich.



DIESEL STARTING BATTERIES

THIS new line of batteries is particularly designed for high current up to 1,600 amp. at low temperature to provide adequate voltage characteristics for starting diesels with high cranking speed. Designed for maximum durability with minimum size and weight. Extra heavy, flexible, lead-plated copper connectors are used between cells to eliminate possible breakage from vibration or expansion due to temperature. Also heavy-duty, genuine, hard rubber monobloc containers to withstand hard usage. Types and sizes for meeting various engine sizes from 25 to 600 hp. where required voltage varies from 12 to 115 volts and current from 300 to 1,600 amp. Designed and constructed especially for truck, tractor, bus and road construction machinery use. Illustrated is 800 to 1,600-amp. type. Engineering service.

Electric Storage Battery Co., Allegheny Ave., Philadelphia, Pa.

CONTACT-MAKING VOLTMETERS

TYPE TSB-20, for feeder voltage regulators, responds more closely to system voltage requirements and eliminates needless operations, thus increasing life of itself and regulator and reducing time. Iron solenoid core is suspended from compensating spring and flexibly spring-coupled to one end of a contact beam, pivoted at center. With given voltage applied to solenoid winding, system is held in mechanical equilibrium by magnetic pulls of solenoid and compensating spring. Beam is fitted with contacts, one each side of center so that as solenoid core raises or lowers with changing voltage, either one contact or other will close circuit to regulator relay switch magnet and cause regulator motor to operate. At instant contacts close, holding coils are energized, providing additional holding pressure and insuring correct performance. Micrometer adjustments to hold mean voltage level and regulate width of voltage band. No-voltage cutout below solenoids. Other features.

General Electric Co., Schenectady, N. Y.

ROLLER-BEARING SHACKLE FOR GOVERNOR ROPES

FITTED with tapered roller bearings, the Culp improved safety shackle provides for rotation of elevator governor ropes to distribute wear evenly over their whole area, thus increase life. Socket and yoke are malleable chrome-nickel steel with tapered roller bearing between. Shackle is applied at car, as is rigid type, but roller bearing prevents subjecting rope to severe twisting actions, present with fixed sockets. Socket connects to one end of governor rope, yoke to safety-rope fitting on car.

Culp Mfg. Co., Dallas, Texas. Eastern representative, F. E. Lister, 114 W. 27th St., New York, N. Y.

FLEXIBLE COUPLINGS

"FABCO" Type R link-and-pin type flexible coupling with two flanges joined together by alternate pins connected to opposite ends of rubber-bushed metal links. Oval steel pin blocks are set in rubber within circular link-end, pin block being oval to maintain constant bearing surface on rubber under all conditions of load. Coupling halves aluminum alloy instead of former welded steel to reduce weight. Sizes from 1 in. to 12 in. bore to transmit 7.5 to 900 hp. per 100 r.p.m. at speeds from 2400 for smallest to 450 r.p.m. for smallest. Earlier design described page 673, April 29, 1930, *Power*. Bulletin.

F. A. B. Mfg. Co., 67th & Vallejo Sts., Oakland, Calif.

SIDE-SUCTION CENTRIFUGAL PUMP

TYPES B and C pumps handle capacities up to 500,000 g.p.d., or 450 g.p.m., at heads to 100 ft. Impeller blade angles and water channels produce most efficient operation over broad working range. Cast-iron impellers with minimum machining for longer wear. Only moving parts are shaft, impeller and bearing. Heavy-duty ball-bearing at pulley end of shaft takes thrust load and belt pull, and grease-lubricated sleeve bearing takes load at impeller end. Water piped to this bearing for lubrication in case grease supply fails. Thrust bearing adjustable to take up wear between impeller and casing by shims. Frames one-piece castings. Shaft, carbon steel. Type B unit illustrated. Bulletin CP11.

Gardner-Denver Co., Quincy, Ill.

PAPER-INSULATED CABLE

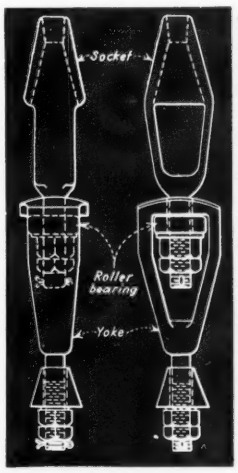
FIVE improvements include compact-strand conductor which reduces cable diameter, gives a higher dielectric strength, lowers a.c. resistance, and gives longer life. Segmented construction in large single conductor cable instead of former annular design to increase current-carrying capacity for a given diameter. Layers of insulation graduated with "superdense" paper next to conductor to improve mechanical and dielectric strength. Insulation washed in CO_2, providing more thorough impregnation and eliminating oxygen and moisture. Lead sheath applied by G. E. hydrogen process to eliminate oxidized areas and avoid weak and inferior spots. Metal shields interlock with paper tapes on Type H cable, to give better shielding.

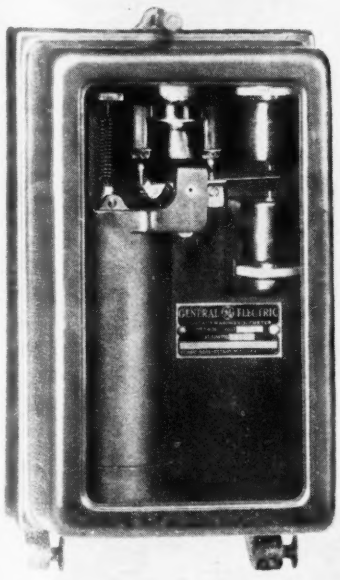
General Electric Co., Schenectady, N. Y.

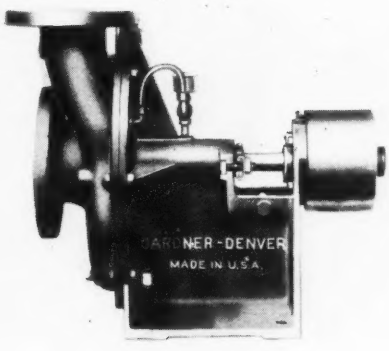
SIMPLIFIED TIME-CYCLE CONTROLLER

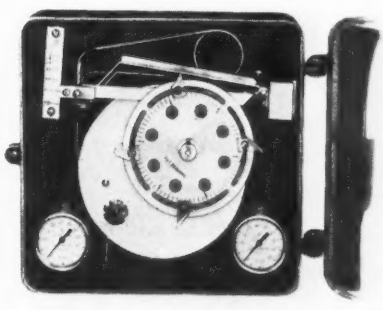
CONTROLS automatic, intermittent operation of diaphragm valves or other diaphragm-operated devices. Simple, dependable, adaptable, low in price. Called "Intermitter," and differs from company's time-cycle controller in that it is limited to repetition of one operation, while other controller handles a number. Circular cam with actuating lugs placed as desired, instead of usual fixed cam. Up to 20 lugs can be used. Duration of operation adjustable by moving nozzle-carrying bracket (upper left). Cam driven by spring clock, either 1-, 6-, 12- or 24-hr. rotation period. Electric clocks if preferred. Two types, Direct-acting, in which lugs open nozzle to relieve pressure from diaphragm motor, and reverse-acting, in which lugs close nozzle to apply pressure. Can be mounted on motor or nearby, and can be set up to operate several valves, depending upon operating conditions and nature of control. Uses air or gas at 25 lb. constant pressure.

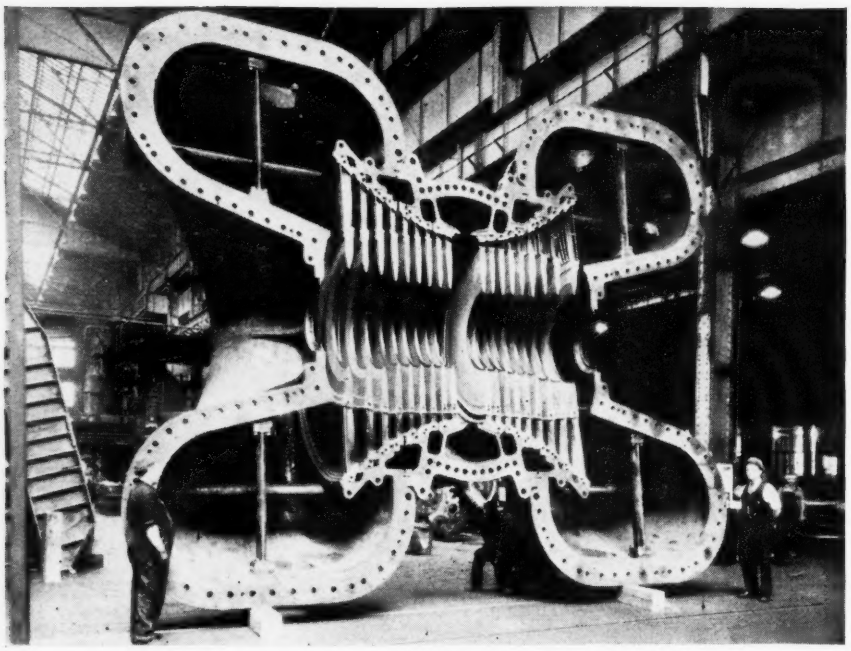
Taylor Instrument Companies, Rochester, N. Y.











VERTICAL-COMPOUND TURBINE TOP FOR FORD

The second 110,000-kw. for the Ford River Rouge plant (see *Power*, Feb., page 66) is being constructed at Schenectady by G. E. Shown is the top half of the low pressure steam turbine casing and exhaust hood with diaphragms assembled. The new unit will use steam at 1,200 lb. pressure and 900 deg. F. It is a vertical-compound unit, with the high pressure turbine and generator mounted directly on top of the low pressure turbine and generator. General dimensions are: 57½ ft. long, 23-ft. maximum width, and a little less than 21-ft. over-all height above the floor. It will weigh approximately 2,000,000 lb.

POWER LINES

Electricity Use Breaks Record

Output of electrical energy by utility companies during the second week in June was not only largest ever recorded for any week in that month, but for any week in period from mid-March to mid-August, *Electrical World* reports. Despite normal summer decrease in lighting, week's production was as high as in the latter part of February and higher than in any intervening week. Unusual condition is ascribed to enhanced industrial activity, calling for more power in manufacturing.

Reported sales of electrical energy to large consumers during April, according to latest available classified figures, indicate a resumption of the upward movement in industrial activity. This type of use generally decreases somewhat in winter and rises in summer. The recession last winter was smaller than usual, and the rise began in January, with consumption holding level during the next two months. The April figure was nearly 7% higher than in 1934 and 37% above the month in 1933.

I.A.A. To Meet in Cleveland

International Acetylene Association will hold its 36th annual convention this year in Cleveland at the Cleveland Hotel Nov. 12-15. New developments in the oxy-acetylene process, and application to industrial problems will be discussed by leading welding engineers. Copies of program from Association's headquarters at 30 East 42 St., New York, N. Y.

Boiler Manufacturers Meet at Skytop

Apparently the Pocono Mountain atmosphere of Skytop Lodge, Skytop, Pa., appeals to boiler builders, for the American Boiler Manufacturers Association and Allied Industries met there on June 10 for another consecutive year. This 47th Annual Convention lasted three days, featured business sessions in the morning, golf in the afternoon and get-together banquet.

By unanimous vote, an expression of affection was sent to Fred R. Low, editor emeritus of *Power*, long confined to his bed in Passaic, N. J.

Officers reelected were: Owsley Brown, president; Starr H. Barnum, vice-president; A. C. Baker, secretary-treasurer. The following constitute the executive committee for 1935-36: Owsley Brown, Springfield Boiler Co.; Walter F. Keenan, Jr., Foster Wheeler Corp.; E. T. Knoblock, Union Iron Works; C. H. Miller, E. Keeler Co.; A. C. Weigel, Combustion Engineering Corp.; Starr H. Barnum, Bigelow Co.; F. H. Daniels, Riley Stoker Corp.; M. E. Finck, Murray Iron Wks.; A. G. Pratt, Babcock & Wilcox Co.; A. W. Strong, Sr., Strong-Scott Mfg. Co.; R. B. Mildon, Westinghouse Electric & Mfg. Co.; R. B. Dickson, Kewanee Boiler Corp.

"Engineering" Celebrates King's Jubilee

The King's Silver Jubilee is being made a great event in Great Britain and in all British dominions. Dedicated to their Majesties George V and Queen Mary, a special Jubilee Section of "Engineering" was published May 3. Thirty-nine distinguished authors each in a page summed up advancements in the various engineering fields. The general introduction is by Lord Weir. Summaries touching the power field are: "Fuels" by Sir Harold Hartley, "Industrial Research" by Sir Frank E. Smith, "Hydro-Electric Power," by Sir Alexander Gibb, "Steam Production," by Sir John Dewrance; "Central Power Stations," by Sir Arthur H. Preece, "High-Voltage Power Transmission," by Sir Thomas O. Callender, "Electrical Machinery and Equipment" by Lord Hirst of Witton.

Nestles Modernizes Its Boiler Plant

The first unit of a boiler-house modernization project at the Marysville, Ohio, plant of Nestles Milk Products, Inc., went into operation June 10. This unit is the first of three 3,500-sq.ft. water-tube boilers being installed to replace four 1,500-sq.ft. h.r.t. units which operated at 125 lb. pressure and 200% rating. The new Union Iron Works boilers are designed for 199 lb. pressure, but will operate for the present at 150 lb. They are to be fired by Detroit Roto stokers, capable of producing 250% rating. The boilers will be set with air-cooled Plibrico plastic refractory, with carborundum brick used at the stoker clinker line. A 315-ton outside silo will be erected with a screw conveyor to transport coal from the silo to the boilers. A complete set of instruments, including flowmeters, CO_2 recorders, draft indicators and pyrometers, is being installed. The complete project, including revamping of the piping, is expected to cost about $75,000.

Dam Tester

Apparatus which combines centrifuge and photo-elastic units, to spy out weak points in structures such as mines and dams, and record the danger spots on film, has been invented by Prof. Philip B. Bucky of the Columbia University School of Mines. Developed through research sponsored by the Engineering Foundation the invention shows where breaks may occur and where reinforcement of materials is needed.

Washer, Rivet, Standards

Proposed American Standards for large rivets, ½ in. nominal diameter and larger and for plain washers for use with American

Standard regular bolt heads and nuts have recently been completed. Proposed standards are now being distributed to industry for criticism and comment by C. B. LePage, Asst. Sec'y., A.S.M.E., 29 West 39 St., New York, N. Y.

A.I.E.E. Holds 51st Summer Convention

The 51st annual summer convention of the American Institute of Electrical Engineers was held on the campus of Cornell University, Ithaca, N. Y., June 24 to 28. An excellent program included talks, recreation, social functions and an enlarged technical program consisting of ten sessions, and, in addition, a number of informal technical conferences. Of the many papers presented, the three read and discussed at the meeting sponsored by the Committee on Power Generation, H. W. Leitch, chairman, are of particular interest to power engineers.

L. N. McClellan, electrical engineer, U. S. Bureau of Reclamation, delivered a comprehensive paper, "Engineering Features of Boulder Dam and Power Plant." The dam, which is 726 ft. high and 1,180 ft. long at the crest, and which contains 3,250 cu.yd. of concrete, will create a reservoir having a capacity of 30,500,000 acre-ft. The power plant is designed for an ultimate installation of fifteen 82,500-kva. units, and two 40,000-kva. units, making a total ultimate capacity of 1,337,500-kva. The large generating units are driven by 115,000-hp. Francis-type waterwheels, and the small generators by 55,000-hp. waterwheels. It is now expected that the initial installation, which will consist of four large units and a small one, will be ready for operation about March 1, 1936, and two additional units will be ready for operation Jan. 1, 1938.

A great deal of interest has been centered in the work being done by Detroit Edison Co., in rehabilitating its Connors-Creek plant. A paper by R. E. Greene, of that company, covers this work. A story of this work appeared in February *Power*, page 62.

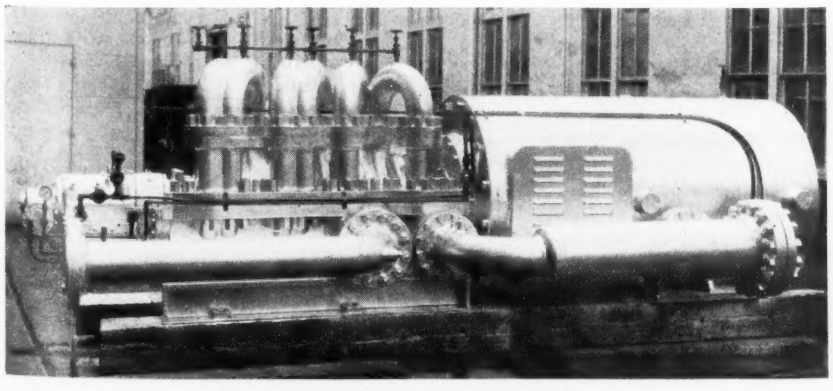
Another interesting plant, the Chas. R. Huntley Station No. 2, in Buffalo, N. Y., on the Niagara-Hudson system, was discussed in a paper by H. M. Cushing, chief engineer, Buffalo-General Electric Co. This plant has two single-spindle turbo-generator units each rated 80,000 kw., 12,000 volts, and operate at 1,800 r.p.m. Four boilers are installed, each of such capacity that three boilers will deliver, continuously, the required 1,630,000 lb. of steam per hr. required for 160,000-kw. station output.

Motor-operated turning devices rotate each of the turbines at 1 r.p.m. during idle but available periods to facilitate starting. This device has reduced normal starting time from 90 min. to 45 min.; in an emergency a unit can be brought up to speed in 25 min. After trying several loading cycles, such as increasing the load 10,000 kw. every 10 min., it was decided to determine how quickly a turbine that had been carrying 5,000 kw. for an appreciable time could pick up load. Accordingly, a test was made by increasing the load on one machine from 5,000 to 85,000 kw., and simultaneously decreasing the load on the other machine by the same amount. This transfer of load was accomplished in 33 sec., without any evidence of undue strain on either machine.

E. B. MEYER, chief engineer, Public Service Electric & Gas Co., Newark, N. J., was elected president of the Institute for the year beginning Aug. 1. Other officers elected were: vice-presidents: W. H. Harrison, Philadelphia, Pa.; Mark Eldredge, Memphis, Tenn.; R. H. Fair, Omaha, Neb.; N. B. Hinson, Los Angeles, Calif.; C. V. Christie, Montreal, Canada. Directors: C. R. Jones, New York, N. Y.; W. B. Kouwenhoven, Baltimore, Md.; G. C. Shadd, Lawrence, Kans., National Treasurer, W. I. Slichter, New York, N. Y. (reelected).

Carbon Brush Practice

Simplified Practice Recommendation R56-35, Carbon Brushes and Brush Shunts, accorded the required degree of acceptance by industry, became effective July 1. The revision includes two main divisions, "Dimensions and Tolerances for Carbon, Graphite and Metal-Graphite Brushes," and "Definitions." Illustrations show dimensions, applications and shapes. Copies from Division of Simplified Practice, National Bureau of Standards, Washington, D. C.



PUMP MOTOR COOLED BY GASOLINE

A 400-hp., 6-in., 8-stage, Byron-Jackson Rannett centrifugal pump unit for Great Lakes Pipe Line Co. The motor is enclosed in a welded-steel double shell tested to 1,200 lb. hydrostatic pressure, closed by cast iron end covers. Gasoline pumped, which varies between 60 and 75 deg. F., passes between the shells to cool the motor. Higher heat transfer rates of liquids permit material reduction of motor diameter for a given capacity.

COMING MEETINGS

American Welding Society—Fall meeting in conjunction with National Metals Exposition, Chicago, Ill., Sept. 30. W. Spraragen, secretary, 29 West 39th St., New York N. Y.

Ass'n of Iron & Steel Electrical Engineers — Annual convention and exposition, Wm. Penn Hotel, Pittsburgh, Pa., Sept. 24-26. Headquarters, 1010 Empire Bldg., Pittsburgh.

15th Exposition of Chemical Industries—Grand Central Palace, New York, N. Y., Dec. 2-7. Charles F. Roth, manager, Grand Central Palace, New York, N. Y.

National Ass'n of Power Engineers—Annual convention, Wm. Penn Hotel, Pittsburgh, Pa., Aug. 26-30.

7th Midwest Power Show—Chicago, Ill., Oct. 14-18. G. E. Pfisterer, managing director, 1 North LaSalle St., Chicago, Ill.

Smoke Prevention Ass'n

Papers before the meeting of the Smoke Prevention Ass'n in St. Louis, June 4-7, of particular interest to power engineers included: Measuring Smoke Densities with Photo-electric Cell Indicators and Recorders, Modernization of Boiler Furnaces for Increased Combustion Efficiency and Smoke Abatement, Smoke Abatement, Elimination of Solids from Chimney Discharge and Methods of Testing and Measuring, Commercial Aspects and Development of Mechanical Solid-Fuel Firing, Characteristics of Underfeed Stokers.

J. C. Bryan, smoke commissioner, St. Louis, was elected president of the Association, W. E. E. Koepler, secretary of Pocahontas Operators' Assn., 1st vice-president; J. D. Clark, fuel supervision of C.&O.R.R., 2nd vice-president; F. A. Chambers, chief smoke inspector, Chicago, secretary-treasurer; James Powers, traveling engineer, C.J.R.R., Chicago, sergeant-at-arms. The 1936 convention will be held in Atlanta, Ga.

C. V. Beck, coal man of St. Louis, said in his address:

. . . "*The F.H.A. 5-year loan plan is the greatest Godsend to smoke abators that could have happened.* I regard it as the most important thing in smoke abatement work that has happened in a decade. You can now really go up to a small user and tell him what he should do, exhort and probably force him to do it without any hardship, whereas a year or two ago it was just utterly impossible to go to a party who couldn't even pay his taxes and insist that he revamp his equipment when you knew it was going to require a large cash outlay. Finances have been the chief obstacle—*Now this is largely solved.*"

Frank A. Chambers, reading a paper by I. A. Deutch, said in part:

"If one closely examines the emission from a stack burning a high-sulphur coal, he will note that the point of maximum concentration is not at the top of the stack, just as the gases leave it, but some distance away. Unlike other forms of smoke which dissipate as the smoke leaves the top of the stack, an emission resulting from the use of high-sulphur coal will appear to condense as it travels away from the stack. And that is just what is happening. The temperature of the flue gases are being lowered below the dew-point and the sulphuric acid mist is formed

which produces the typical bluish-white emission. . . .

To further corroborate this explanation of the cause of this bluish white haze, an examination of the gas travel through the settings of a number of water-tube boilers was made by engineers of the Smoke Department of Chicago. In no case were they able to note any visibility of the gases of combustion as the gases traveled through the various passes of the boiler. It was only when flue gases were examined in the breeching after having left the preheater that these men were able to note any mist forming. This occurred at plants where the temperature of the flue gas after leaving the preheater was below 300 deg. F. The gases were further lowered in temperature beyond this point as it was necessary to open a clean-out door to inspect the gas travel. The temperature at this point therefore was reduced to between 230 and 260 deg. F. At these temperatures which was below the dewpoint of the sulphuric acid in the flue gas, the gases of combustion were no longer clear and colorless (as they appeared in the setting of the boiler) but had become clouded with a mist which decreased one's vision. A beam of light could not penetrate the gases as clearly as it had done in the last pass of the boiler where the temperature of the flue gas was between 500-600 deg. F.

An analysis of these observations leads definitely to the conclusion that a condensation of some vapor is occurring. As the emission increases in density as higher sulphur coals are burned, one can very definitely conclude that sulphur in the coal is responsible for this bluish white emission.

OBITUARIES

FREDERICK N. CONNET, 67, chief engineer of Builders Iron Foundry, Providence, R. I., until his retirement five years ago, died in Providence, June 18, after an illness of several years. He was widely known as inventor of automatic registering devices for use with the Venturi tube. He was a John Scott medalist of the Franklin Institute.

WALTER FRANCIS COTELL, 52, engineer of Chatham-Massachusetts Water Co., died from a heart attack June 9.

JAMES CAMPBELL, 60, operating steam engineer in the Boston banking district until last February, died in Brighton, Mass., June 15.

HUGO ROCKTASHEL, 44, general sales manager of the New England Power Association, Boston, died suddenly June 20. He had been connected with the power industry for 25 years.

WILLIAM J. SILK, member of the power-plant engineering staff of the North Shore Ice Co., Boston, Mass., died June 3 while on duty in the refrigerating division of that concern.

CHARLES P. DICKINSON, 81, builder and operator of hydro-electric plants in the central Hudson Valley of New York, died June 11. During his 24-year connection with power-plant service he built and operated four plants on the Roundout River under the firm name of Honk Falls Power Co., selling them to the Central Hudson Gas & Electric Co. in 1920.

PERSONALS

F. H. ROSENCRANTS was elected a vice-president of Combustion Engineering Co., Inc., 200 Madison Ave., N. Y., and will assume charge of the Proposition Engineering Department. He was at one time mechanical engineer with Electric Bond & Share Co., and later Chief Engineer of International Combustion, Ltd. of England.

LOUIS H. BRENDEL has joined Consolidated Ashcroft Hancock Co., Bridgeport, Conn., as asst. sales manager of Hancock Valve Division.

JOSEPH ALLEN JOHNSON, chief electrical engineer of Buffalo, Niagara & Eastern Power Corp., has received the honorary degree of Doctor of Engineering from Worcester Polytechnic Institute.

E. A. CARPENTER has been elected secretary of E. F. Houghton & Co., Philadelphia, Pa., to fill the vacancy caused by the death of A. Everly Carpenter, III.

EUGENE F. ZEINER, for the past ten years district representative of Philip Carey Co., New York, has become district manager for Refractory & Engineernig Corp. in eastern Pennsylvania, northern Delaware and Maryland, with offices in Packard Building, 15th & Chestnut Sts., Philadelphia, Pa.

ALBERT C. BRUCE, president of the U. S. Hoffman Machinery Corp., has been elected to the board of directors of Worthington Pump & Machinery Corp., Harrison, N. J.

GEORGE B. CORTELYOU, former president of the Consolidated Gas Co., New York, N. Y., retired July 1 since he was past the retirement age specified in the plan adopted by the company. He was succeeded by Frank W. Smith, former president of the N. Y. Edison Co., and the United Electric Light & Power Co. Mr. Cortelyou, who was Secretary of the Treasury during Theodore Roosevelt's administration, was also the first Secretary of the Department of Commerce and Labor and later became Postmaster General. He is a past-president of the National Electric Light Ass'n, American Gas Ass'n, and the Edison Electric Institute.

Other officers affected by the plan are: John A. Garver, director and member of the Executive Comm.; H. L. Snyder, president, New York & Queens Electric Light & Power Co.; W. G. Hoyt, president, Standard Gas Light Co. of the City of New York; E. S. Bellows, treasurer, Westchester Lighting Co., and Yonkers Electric Light & Power Co.; C. A. Barton, vice-president, New York & Queens Electric Light & Power Co.

FRANK J. TONE, president, Carborundum Co., was awarded the honorary degree of Doctor of Science by the University of Pittsburgh June 5.

RALPH P. KNEELAND, master mechanic U. S. Navy Yard, Boston, Mass., has been elected president of the Plant Engineers Club of Boston for 1935-6, and W. S. Baldus, assistant plant engineer, United Shoe Machinery Co., Beverly, Mass., has been elected secretary-treasurer.

JAMES BURKE, chairman of the Board and a director of Burke Electric Co., Erie, Pa., retired May 21, after being active head of the company since its inception 31 years ago. He will in future engage in engineering research and in an advisory capacity to the electrical manufacturing industry. Other officials of the company, headed by Wm. M. Spencer as president, were re-elected.

GEORGE L. BOURNE, Samuel G. Allen, and Frederic A. Schaff have been appointed the executive committee of Superheater Co., 60 East 42nd St., New York. Mr. Allen was elected chairman of the committee, and Thomas F. Morris was elected secretary and assistant treasurer of the company.

J. W. BARNETT, recently director of the Division of Construction & Finance, U. S. Shipping Board, has joined Babcock & Wilcox Co.'s Marine Department.

H. J. SAYER was elected president of Vancouver Electrical Association with S. F. Ricketts as vice-president, J. C. Reston, secretary, T. Smither, treasurer, T. C. Simmons, D. Niven, A. W. Hunter, T. Barwood, R. Hall, and R. G. Wallace on the executive board.

OLIVER D. DALES, chief civil engineer, Buffalo, Niagara & Eastern Power Corp., was awarded the degree of bachelor of science by Michigan State College. He has been identified with the power industry of the Niagara Frontier for 31 years.

CHARLES T. MAIN, water power and industrial consultant at Boston, Mass., past president of the A.S.M.E., and of the Amer. Inst. of Consulting Engineers, was accorded the honorary degree of Doctor of Engineering at Northeastern University, June 18.

WM. R. VAN NORTWICK, for many years identified with boiler and combustion work in New York, has joined the boiler sales division, Henry Vogt Machine Co., Louisville, Ky., working from the New York office at 80 Broad St. Robert F. Koch, formerly with Foster-Wheeler, is now representing Vogt as boiler sales engineer in the Cleveland territory, with headquarters at 1005 Rockefeller Bldg.

E. D. WACKER has been appointed assistant general sales manager of C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.

LEE WRIGHT has been appointed Salt Lake City sales representative for Republic Steel Corp., with offices at 401 Atlas Bldg.

E. R. SHERIDAN has been appointed New York district manager, Industrial Stoker Division, Combustion Engineering Co., Inc., 200 Madison Ave., N. Y.

R. T. PIERSON has been elected vice-president and general manager of USL Battery Corp., Toledo, Ohio. He was formerly manager of the power battery division.

BUSINESS NOTES

FISHER GOVERNOR CO., Marshalltown, Iowa, celebrated its 55 years in business May 22 to 24 with a monster sales convention. Every one of the 48 states and several of the Canadian provinces were represented at the meeting by company agents.

CHASE BRASS & COPPER CO., Waterbury, Conn., Hays Corp., Michigan City, Ind., Jones & Laughlin Steel Corp., Pittsburgh, Pa., Revere Copper & Brass, Inc., and Toledo Scale Co., Toledo, Ohio, have become members of Exhibitors Advisory Council, Inc.

MCCLAVE-BROOKS CO. has added four representatives: R. J. Bearings Corp., 3133 Olive St., St. Louis, Mo.; Briggs-Weaver Machinery Co., 309 No. Market St., Dallas, Tex.; W. C. Christensen, 129 Texas Ave., Jackson, Miss.; Wm. F. Devendorf & Co., 127 Railroad Ave., Rochester, N. Y.

BRUCE-MACBETH ENGINE CO., Cleveland, Ohio, has appointed Geo. M. Williamson representative in Texas, with offices at 2904 Hemphill St., Fort Worth. He succeeds Dana G. Griffin, who died recently.

NATIONAL-SUPERIOR CO., Springfield, Ohio, has appointed Joseph H. Strunk, 1877 S. W. Eleventh St., Miami, Fla., as Florida representative for its diesel engines. He succeeds R. E. Hoffman who has been transferred to Springfield, Ohio, to supervise diesel sales in states south of Ohio and east of the Mississippi.

ARMSTRONG BROS. TOOL CO., Chicago, Ill., has purchased the line of Ideal chain tongs from Carrier Engineering Corp., Newark, N. J. This type of tong was formerly manufactured by Brunswick-Kroeschell Co., and later taken over by the Carrier Corp.

COMPAGNIE DES SURCHAUFFEURS, Paris, France, has moved to Rue de Berri 29.

LEEDS & NORTHRUP CO., Philadelphia, and George Kent Ltd., of Great Britain have reached an agreement applying to sale of industrial electro-chemical instruments and certain types of blowmeters.

A. P. GREEN FIRE BRICK CO., Mexico, Mo., is commemorating its silver anniversary. A profusely illustrated, 3-color, 12-page booklet has been published illustrating the company's 25 years of progress. A. P. Green, president, was awarded the honorary degree of doctor of engineering, May 25, by Missouri School of Mines.

MORSE CHAIN CO., Ithaca, N. Y., and Detroit, a division of Borg Warner Corp., has elected the following officers: D. B. Perry, president; C. J. Kenerson, vice-president, general manager and treasurer; N. K. Van Osdol, secretary and assistant general manager; S. B. Waring, assistant secretary and assistant treasurer.

GENERAL REFRACTORIES CO., 106 South Sixth St., Philadelphia, has appointed the following agents: Broadway Mfg. Co., Knoxville, Tenn.; Shadbolt & Boyd Co., Milwaukee, Wis.

BURNS & MCDONNELL ENGINEERING CO., Kansas City, Mo., has established an engineering office in the Home Savings Bank Bldg., Albany, N. Y., in charge of Hartwell J. Rosson, formerly in charge of the Cincinnati office. The Cincinnati office is now in charge of M. C. Bartlett.

NORTON CO., Worcester, Mass., has combined sales of all abrasive products into the Abrasive Division, consisting of two parts, Sales Planning and Development under C. W. Jinnette as regional manager, and Sales Operation. P. H. Clapp moved to Detroit to take over Mr. Jinnette's work as district manager for the Michigan, while P. S. Wiswell takes over Mr. Clapp's former position on the Pacific Coast.

LUBRICATION PRODUCTS CO., Cleveland, Ohio, has moved its offices to 1400 West 25th St.

T. A. CANTY, Baltimore, Md., distributor of Lincoln arc welding equipment and supplies, has moved to 1023 Cathedral St.

ROSS HEATER & MFG. CO,. Buffalo, N. Y., has moved its New York office to 40 West 40th St.

SULLIVAN MACHINERY CO., has moved its general offices to the Bell Building, 307 North Michigan Ave., Chicago, Ill.

RAY PRESSURE SNUBBER CO. has moved its offices from Charlotte, N. C., to 3722 82nd St., Jackson Heights, N. Y.

REPUBLIC STEEL CORP. has removed its Buffalo, N. Y., district sales office from 475 Abbott Road to 1020 Liberty Bank Bldg.

HORACE T. POTTS CO., Philadelphia, Pa., has been appointed distributor there for seamless stainless-steel pipe of Babcock & Wilcox Tube Co., 85 Liberty St., New York, N. Y.

ERNST WATER COLUMN & GAGE CO., Newark, N. J., has appointed MacDonald Sales & Engrg. Co., 6312 Sherwood Road, Philadelphia, for the Philadelphia and Baltimore district.

HEMPHILL DIESEL SCHOOLS, 3128 Queens Blvd., Long Island City, N. Y., held its first annual diesel show June 15-23. A number of diesels were exhibited, principally high-speed automotive and railroad types.

STRAWS

Pointing the way business winds blow

SPOKANE, WASH., will install three 1,800-hp. adjustable-blade propeller-type water turbines and three 1,625-kva. 2,300-volt generator units in new municipal hydro-electric power plant for waterworks pumping service, recently referred to in these columns. A 59-ft. power dam will be built of the 8-gate spillway type. Project in charge of municipal water department, Alexander Lindsay, supt., and equipment bids will be asked in near future. A fund of $625,000 has been arranged.

MCKNAB OIL & GAS CO., St. Louis, Mo., represented by James A. Waechter, Telephone Bldg., attorney, is securing a local franchise for natural gas supply and proposes to construct a welded steel pipeline from fields near Bowling Green, Ky., to St. Louis and vicinity. Project estimated to cost in excess of $4,000,000. Financing being arranged through Bills Corp., 134 South LaSalle St., Chicago, Ill., investments, B. F. Bills, president.

EDMONTON, ALTA., will spend $1,064,000 extending the city power plant as soon as money can be obtained or bonds sold to equipment suppliers. Commissioners are preparing specifications. Later information indicates plant can be erected for $600,000, and financed by selling bonds to citizens.

ELWOOD MEAD, Reclamation Commissioner, said recently that more than half the money allotted to Boulder Dam construction has or will be used in the purchase of material. During the 4 years construction has been in progress, $23,631,427 has been spent on material and equipment, freight on which cost an additional $5,500,000. The Bureau has yet to buy $8,000,000 worth of pipe and $14,000,000 of power-house equipment.

REPUBLIC STEEL CO., Warren, Ohio, has awarded Westinghouse a contract for motor and control equipment for a new 42-in. reversible cold-strip mill. Amounting to approximately $100,000, the order includes a 1,200-hp. mill motor and two 300-hp. reel motors.

GREENWOOD, MISS., will have plans prepared soon for extensions and improvements to municipal electric plant, including equipment for increased capacity, as well as replacements. Project will cost about $200,000. Proposed to ask bids soon. Burns & McDonnell Engrg. Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer.

U. S. ENGINEER OFFICE, Commerce Bldg., St. Paul, Minn., has awarded contract to A. S. Schulman Electric Co., 537 South Dearborn St., Chicago, Ill., for new power control and lighting system at Lock and Dam No. 5-A, Mississippi River, near Winona, Minn., for which bids recently closed, at $81,445.

CONSTRUCTION SERVICE, VETERAN'S ADMINISTRATION, Arlington Bldg., Washington, D. C., will receive bids until July 23 for new boiler plant at institution in Bronx, New York, including complete boiler equipment and accessories.

JACKSON BREWING CO., 620 Decatur St., New Orleans, La., plans construction of boiler plant in connection with proposed new multi-unit brewery at Atlanta, Ga., where site will soon be acquired. Plant will be developed for large capacity and is reported to cost over $750,000, including equipment.

GRAND COULEE DAM plans were extensively altered in a change order signed June 7 by Secretary of the Interior Ickes, calling for construction up to a height of 177 ft. of a complete foundation for the 500-ft. dam. Original plans called for a 297-ft. power dam and permanent cofferdam to be incorporated later into the larger structure.

GREAT LAKES STEEL CORP. has awarded to Westinghouse a $1,000,000 order for motors, power supply and control units, and other electrical equipment for wide, hot and cold strip mills in Detroit. The order includes eight 1,250-hp. d.c. motors and four 6,000-kw. motor-generator sets.

REVELSTOKE, B. C., will construct a $28,000 flume and surge tank at its hydro plant.

JAMESTOWN, N. D., has engaged Pillsbury Engrg. Co., 1200 Second Ave., South, Minneapolis, Minn., consulting engineer, to prepare plans for proposed municipal electric light and power plant, including electrical distribution lines. It is proposed to arrange financing in amount of $650,000 through Federal aid and proceed with project in near future.

KEYSTONE PIPE LINE CO., an interest of Atlantic Refining Co., 260 South Broad St., Philadelphia, Pa., has approved plans for construction of a new welded steel pipeline from near Mechanicsburg, vicinity of Harrisburg, Pa., to Pittsburgh, Pa., about 180 miles, to be used for gasoline transmission. Line will be of 8⅝-in. pipe, and will connect with present pipeline between Point Breeze, Philadelphia, where parent company operates a refining plant, and Mechanicsburg. Cost about $1,500,000. Company engineering department in charge.

BOARD OF DIRECTORS, CHICAGO FEDERATION OF LABOR, 666 North Lake Shore Drive, Chicago, Ill., has authorized plans and will call for bids at early date for new diesel power plant for radio broadcasting station at Downers Grove, Ill. It is reported to cost over $65,000. Burns & McDonnell Engrg. Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer.

CHANDLER HEIGHTS IRRIGATION DISTRICT, Chandler, Ariz., is planning power plant for pumping service in connection with irrigation system. Appropriation of $94,000 secured through Federal aid and work will be carried out during the summer.

GLENNVILLE ICE CO., Glennville, Ga., has plans under advisement for early rebuilding of local ice-manufacturing plant, destroyed by fire recently with loss reported at $50,000, including equipment.

BOARD OF RACINE COUNTY COMMISSIONERS, Racine, Wis., is considering construction of new power plant and central heating system at county asylum and home. Estimates will be made. County engineer in charge.

COMMANDING OFFICER, PICATINNY ARSENAL, Dover, N. J., plans extensions and improvements in power plant, including new equipment. Work will be carried out in conjunction with new shops and warehouse building at arsenal. A total approximation of $920,246 is being arranged.

BOARD OF EDUCATION, East Sixth & Rockwell St., Cleveland, Ohio, will receive bids until July 15 for boilers, stokers and auxiliary equipment for public school. Estimated cost $45,000. McRea Parker, director of schools.

LODI, CALIF., has concluded arrangements for a Federal loan and grant for $600,000 for proposed new municipal hydro-electric generating plant on Mokelumne River, and will hold early special election for final approval. Plans in progress for power plant.

A GROUP of independent natural-gas operators in the Montana gas fields, represented by Alva M. Drake, 2420 Humboldt Ave., South, Minneapolis, Minn., has tendered a proposition for natural-gas supply at Duluth, Chisholm and Hibbing, Minn., now being considered favorably by the city councils in these municipalities. It is proposed to construct a welded steel pipe line from the Montana fields, with booster stations and distributing plants in the communities noted. Entire project will cost close to $35,000,000 and financing will be arranged through Federal aid.

FORT MILL, S. C., is planning new municipal electric plant. Cost estimated at $41,000. Application has been made for Federal grant and loan. Proposed to begin work at early date. Luther G. Patterson, mayor, active in project.

WOOD RIVER, ILL., is having surveys and estimates of cost made by Burns & McDonnell Engrg. Co., 107 West Linwood Blvd., Kansas City, Mo., consulting engineer, for proposed municipal electric plant, financing will be arranged through Federal aid.

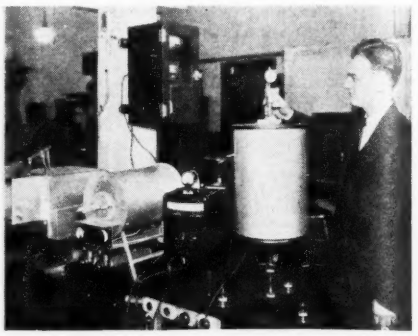
ATHENS, OHIO, is considering preliminary plans for new municipal electric plant. Cost about $400,000, including distribution. Application being made for Federal grant and loan.

CHEMICAL PAPER MFG., CO., Holyoke, Mass., started construction July 1, of a new hydro-electric installation with two 800-kw. units to replace a mechanical water-wheel layout of ten machines. Water supply will be taken from the 3rd-level canal leading from the Connecticut river, and normal head will be 20 ft. The present 300-ft. head race and 150-ft. tail race will be utilized, but the existing stone pit and wooden flume will be replaced by concrete construction. The generators will be 3-phase, 600-volt, G. E. machines and the turbines of S. Morgan Smith make, with Kaplan adjustable runners. The existing connection with the Holyoke municipal plant will be retained. Daniel O'Connell's Sons, Inc., Holyoke, are contractors.

DEPARTMENT OF HOSPITALS, Municipal Building, New York, N. Y., plans new boiler plant at Neponsit Beach hospital, Queens Borough, in connection with group of new mechanical buildings at institution. A fund of $477,000 will be arranged through Federal aid.

FEDERAL POWER COMMISSION has been allotted $125,000 to continue the electric rate survey and the national power survey. $25,000 will be used for tabulation and analysis of investigation of rates paid for electric light and power by Federal agencies and institutions; $25,000 for special field investigation of the power requirements and power resources in the T.V.A. area, and $75,000 for the completion and publication of studies by the Federal Power Commission.

PLANS ARE UNDER WAY for construction of a number of new distilleries in Kentucky, to include steam power plants for operating service, as well as motors and other electrical equipment in different works departments. Ripy Bros., Lawrenceburg, Ky., Ernest Ripy, head, has authorized a new multi-unit distillery at Tyrone, Ky., with capacity of about 50 bbl. per day, scheduled to be ready in the fall; it will cost over $150,000, with machinery. Paul Gerhardt, 64 West Randolph St., Chicago, Ill., architect and engineer, is completing plans for a large distilling plant on Winchester Ave., Ashland, Ky., for a new company now being organized by Chicago interests; it will comprise several one- and multi-story units, with steam power house and other mechanical departments, and will be equipped for initial capacity of 350,000 gals. per month, with estimated cost of $500,000. Pattison Bros. Kentucky Bourbon Distillery Co., 133 Park Place, Covington, Ky., is projecting plans for a new distillery unit on River Road, Ludlow, Ky., where large tract of land is being acquired; plant will develop large output and will include boiler house, reported to cost more than $100,000, with machinery. Coffey Distilling Co., Fisherville, Ky., headed by J. R. Coffey, 515 Juanita St., Louisville, Ky., is completing plans for new local plant, including power house, designed for an initial output of about 20 bbl. daily; it will cost about $115,000, including equipment.



WHEN METAL EXPANDS

This dilatometer measures and records in ten-thousandths of an inch the expansion and contraction of metals as they are heated and cooled. Built from Bureau of Standards specifications, it is in the G. E. Schenectady laboratory for investigations of metals.

CULPEPER, VA., municipal light and power plant is a little ahead financially enjoying a net income of $2,510.40 monthly, a gain of more than $2,000 over that made in September, 1934. Total monthly operating costs average around $2,000, varying about $200 a month.

FRASER RIVER, B. C., dam sites for power development, will be examined by provincial government engineers and geologists this year. Three sites, it is estimated, are capable of developing 1,750,000 hp. There is no commercial demand at present but the government is anxious to secure complete data on the possibilities of the sites for future needs. Prospective sites are in gorges above Lillooet, near Moran Siding and in the vicinity of Soda Creek.

PARKHILL BEDDING CO., Erin St. & Notre Dame Ave., Winnipeg, Man., has started erection of a $15,000 power house and small plant addition.

MAINE STATE DEPT. OF PUBLIC INSTITUTIONS, State House, Augusta, Me., has plans maturing for central heating plant at State Reformatory, Skowhegan, Me., including new mechanical laundry plant. Estimated to cost about $65,000, including equipment, and bids to be asked this month. A. J. Thayer Co., 2 Spring St. Extension, Auburn, Me., consulting engineer. Plans to be ready early in fall for extensions and improvements in central heating plant at State Hospital, Bangor, Me., including additional equipment. This will cost close to $40,000. Fels Co., 42 Union St., Portland, Me., consulting engineer.

HOPE ENGRG. CO., 30 Broad St., New York, N. Y., has secured contract for new 6- and 10-in. welded steel pipeline for Cortez Oil Co., Trinity Life Bldg., Fort Worth, Tex., recently referred to in these columns, to run from Samfordyce oil-field district, Hidalgo County, Tex., to new terminals now in course of construction at Port Isabel and Brownsville, Tex., totaling about 85 miles, for crude-oil transmission. Work will be placed under way at early date. Cost about $500,000.

COOPER, TEX., has work under way on new municipal electric plant, for which contract has been let to Central Engrg. & Supply Co., Cooper, at $104,900, including electrical distribution system. Installation will include two Cooper-Bessemer diesel-generator (G.E.) units. Station ready for service late in the summer.

GLADSTONE, MICH., will soon have plans drawn for proposed municipal electric plant, including distribution lines. Project estimated to cost $109,600 and financing arranged through Federal aid. Shoecraft, Drury & McNamee, Ann Arbor, Mich., consulting engineers.

LONE STAR GAS CO., Dallas, Tex., has surveys under way for new welded steel pipeline from natural-gas fields at Long Lake and Cayuga, Anderson County, Tex., to Irving, near Dallas, totaling about 110 miles. 20-in. pipe will be used for majority of distance. New line will follow the Trinity River through Ellis and Navarro Counties, and will connect with present trunk lines at Irving. Capacity for handling over 100,000,000 cu.ft. of gas per day; estimated to cost close to $2,500,000. Work scheduled to begin in about 60 days. L. B. Denning, president.

AETNA PAPER CO., Dayton, Ohio, has plans for extensions and improvements in steam power house at paper mill in the Edgemont district, to include new boilers, pumps and accessory equipment. Project will cost over $50,000, and will be carried out during the summer. W. I. Barrows, Reibold Bldg., Dayton, consulting engineer.

SANFORD, N. C., is considering preliminary plans for municipal electric plant. Program is estimated to cost about $300,000, and financing will be arranged through Federal aid.

SELDOVIA, Alaska, 500 population, has installed a 75-hp., 2-cyl., Fairbanks-Morse "C.O." oil engine. Because of the light load on the new plant at the present time one piston and counter-weights have been removed. The diesel is operating satisfactorily at a fuel consumption of 2¼ g.p.h. The engine room occupies a space 22 x 12 ft. in a 30 x 30-ft. building, the remainder devoted to store, office and living quarters for the crew. The 100-gal. fuel tank is connected directly to Standard oil tanks 650-ft. away.

FAIRFIELD, IOWA, is considering a proposition tendered by Marsh Engrg. Co., Masonic Temple, Des Moines, Iowa, for construction of a municipal hydro-electric plant to serve neighboring communities also. R. W. Curtis, Keokuk, Iowa, is interested and has permit for construction of a dam on the Des Moines River, vicinity of Farmington, Iowa. It is proposed to have the municipality arrange financing through Federal aid, covering a grant of $450,000 as well as loan for close to like amount.

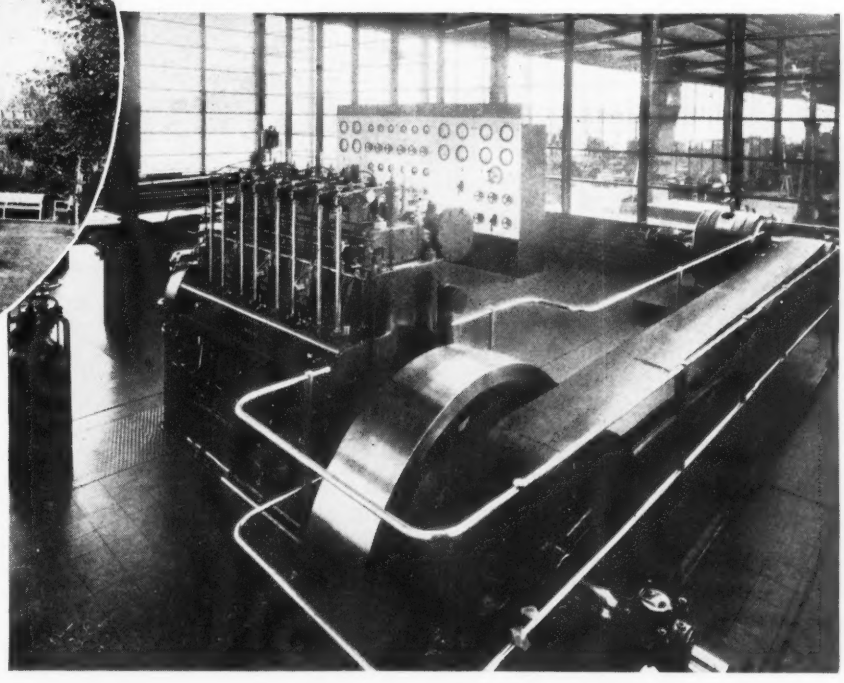
U. S. ENGINEER OFFICE, Portland, Ore., has contracted with General Electric Co., Schenectady, N. Y., for two 43,200-kw., a.c. generator units, vertical-shaft type, 13,800-volt, 60-cycle, 75-r.p.m., with spare parts and complete accessories, for Bonneville Navigation & Power Project on the Columbia River, near Bonneville, Ore., at price of $1,144,800 f.o.b. Schenectady. Next lowest bidder was Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., at $1,181,700, followed by Allis-Chalmers Mfg. Co., Milwaukee, Wis., at $1,191,488. General-Shea Co., is contractor for the power house and lock structures, and work on this part of project is being advanced rapidly (see page 377).

HAMMON CONSOLIDATED GOLD FIELDS Co., Nome, Alaska, has installed 8 diesels for gold dredging service. 6 units are Pacific 525-hp., 6-cyl., 225-r.p.m., air-injection, 4-cycle 14.96 x 24-in., while the other two are Fairbanks-Morse 525-hp., 5-cyl., 300-r.p.m., solid-injection, 2-cycle, 14 x 17-in.

EAST RAND PROPRIETARY MINE, South Africa, has contracted for air-conditioning equipment, following the success of air-conditioning in Robinson Deep. East Rand has shafts to a depth of 6,500 ft., and tunnel temperature of 82.5 deg., with R.H. 100%. The contract requires that air be cooled to 73 deg. F., with 10% reduction of wet-bulb temperature. Air-conditioning equipment will be installed in a room hewn out of solid rock 6,500 ft. below the surface. Water will be carried down from 350 ft. above. Air will be cooled by a system of sprays in the large air washer, and then will be blown into the workings by means of a fan. Plans call for a 150,000 cu.ft. of air per min. in lower levels.

NEW YORK CITY will build a 300-ton incinerator at College Point Causeway, Flushing-Queens, to replace the existing plant. Total cost will be $726,217. Plant will have waste-heat boilers and turbine-generators which will provide current for lighting and powering of plant, and some excess for other municipal operations. Work will be completed in about nine months.

MINERS & MERCHANTS BANK BLDG., Nome, Alaska, is installing two GE air conditioners. The building is of steel-frame construction with 3-in. cork insulation in all exterior walls and roof. The bank will be heated by a split system, utilizing both forced hot water and conditioned air.



GLASS WALLS

Herbert Lindner G.m.b.h., Berlin, Germany, operates a machine tool plant on the principle that every workman shall be able to see green lawns and parks from his bench. Even in the power plant the principle applies. Here is the 200-hp., 4-cyl., M.A.N. diesel in the plant. Another 100-hp. engine is being replaced by a 300-hp. M.A.N. engine. Belt drives are used for easy changes of capacity; spring isolation to avoid vibration.

SQUEAKING WHEELS

I've been talking with the editors of *Power* about this amendment to the Federal Housing Act and what it might do to help me get what I want in my plant. After all, $50,000 won't build me a new plant, but it will go a long way towards getting me the meters and motors and so on that I've been kicking for for a couple of years. It gives me a swell opportunity to go back again with a lot of plans I've had that were turned down because the company didn't have any money. Either they spend their own now or they borrow some, and my figures show that they can pay it back within a relatively short time and make money on the side.

One thing that I simply can't get through my head is that so many brass hats in business can't get it straight that it's just as necessary to *spend* wisely as it is to *sell* wisely. They think profit is gross income, not the *difference* between gross income and gross expenses.

And that goes for companies that make power equipment as well as for my bosses. My job is to make power as cheaply as possible, then to dispose of it. Theirs is to make equipment and dispose of it, and end up with a profit. But how can they dispose of equipment when they aren't patient, persistent and everlastingly helpful in aiding fellows like me to solve our problems? My company is no different than theirs.

When they come to see me, they know only one lesson—stick a head in the door, ask "Wanta buy a compressor today?" and if I say no, out they go. They forget the old saying, "It's the squeaking wheel that gets the most grease" and fail to use new approaches and to give me new reasons for squeaking to my bosses about modernization.

In my humble opinion, FHA has done just that for me—it has given me, and hundreds of other power engineers, a new excuse to squeak, a chance to tell my story again. Most engineers need FHA only for a re-entry or at most as the money to finance buying of a new piece of equipment to convince their management that a whole modernization program they've laid out will do what they say it will.

Now the salesmen's job—if they're interested in selling me something—is not just to wait around until I buy something, but to give me the ammunition I need to prove my suggestions (which of course involve their products) are worth doing. They aren't as smart in trying to sell me as they are in getting their own companies to give them what they want. They're too likely to forget FHA and how they can adapt it to do a job for them.

But I don't blame the salesmen as much as I do their management—good sales policy and selling strategy emanate from the home office. To me a salesman's approach and tactics are an indication of how his bosses feel at home. Therefore, maybe most of what I'm saying is to the salesmen's bosses, not to the salesmen. All I want to do is to warn 'em not to forget the FHA amendment without first trying to use it as a sales tool from one of several angles. If American Radiator and Johns-Manville could do as well with it as they did with their sales outlets on home stuff, certainly it shouldn't be difficult for companies selling the power field to make it a whirlwind success. Those two companies had to sell to plumbers, contractors, carpenters—men who couldn't see the engineering advantages of modernization at all, and who couldn't and wouldn't cooperate. Those companies had to start the whole thing themselves and educate their dealers up to the idea; companies in our field have trained engineers as sales outlets and trained engineers as buyers. It should be a set-up, and probably is.

George Edwards

GEORGE EDWARDS
Engineer

EDGEMOOR BOILERS
STRAIGHT *and* BENT TUBE

Provide ample fire box space for satisfactory combustion. The gas passes vertically in its natural direction. Circulation is uniform throughout the entire width of drum.

Edgemoor superheaters and economizers are readily accessible and are ample in size for desired duty.

Edgemoor Boilers are suspended from overhead supports and lower drum is free from loading.

The excellence of Edgemoor workmanship is well known and passes the most rigid inspection.

Edgemoor water walls reduce maintenance on setting.

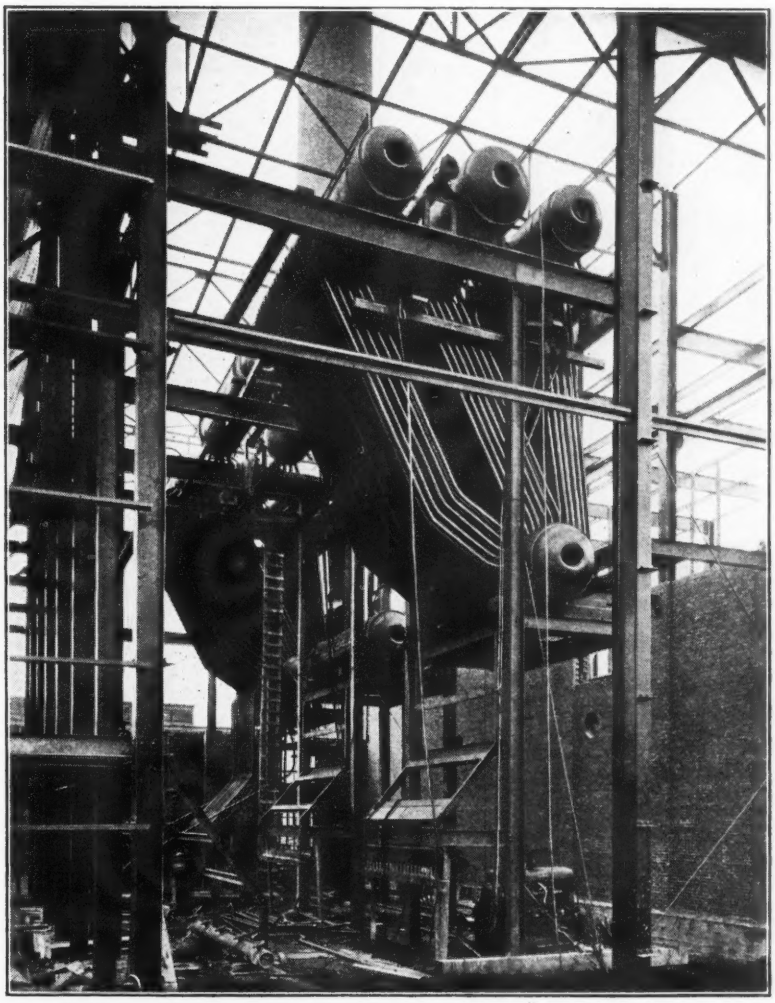
Edgemoor steel encased settings prevent excessive air leakage, thereby increasing efficiency.

Edgemoor design permits of easy access to all interior portions of boiler.

Edgemoor boilers are available for your needs as to size and capacity and your requirements are not disregarded to fit a restricted design of boiler.

For complete overall satisfaction write Edgemoor. Obviously . . . no obligation!

Send for new radiant heat boiler details.



Installation of three EDGEMOOR BOILERS. 180,000 lbs. of steam per hour at a prominent pulp and paper manufacturing plant.

EDGEMOOR BOILERS

EDGE MOOR, DELAWARE

Established 1869

OFFICES IN ALL PRINCIPAL CITIES

STRAIGHT and BENT TUBE BOILERS, WATER WALLS, *Furnace Enclosures* . . . ECONOMIZERS, *Integral or Separate, Flooded or Steaming* . . . SUPERHEATERS, *All Types and Arrangements* . . . WASTE HEAT RECOVERY SYSTEMS for *Blast Furnaces, Cement Mills, Steel Furnaces* . . . DIESEL ENGINE EXHAUST HEAT BOILERS, PRESSURE VESSELS, *Fusion Welded of Various Alloys, Class 1 and 2* . . . CHROME NICKEL and OTHER ALLOY . . . FABRICATION . . . HEAT TREATING and STRESS . . . RELIEVING FURNACE SERVICE . . . X-RAY INSPECTION SERVICE . . . EDGEMOOR PULVERIZERS, *Both Impact and Table Roller.*

NEW BULLETINS

Lubrication—S. F. Bowser & Co., Inc., Fort Wayne, Ind. 11-page "Pulp and Paper Mill Lubrication," and 48-page "Lubrication of Steel Mill Machinery." Both extensively illustrated. Detailed data.

Compressed Air Accumulator — Seamless Steel Equipment Corp., 39 Broadway, New York, N. Y. 4-page bulletin, "Hydraulik" Accumulators, which are units without pistons or floats, and also **hydraulic presses** made by Hydraulik G.m.b.H., Duisburg, Germany.

Ash Conveyor—Girtanner Conveyors & Engineering Co., 30 Church St., New York, N. Y. 8-page bulletin, "Speedveyor Steam-Actuated Pneumatic Ash Conveyor," illustrating and describing unit and showing typical installations.

Soot Blowers—Diamond Power Specialty Corp., Detroit, Mich. 8-page folder. "More Proof of Diamond's **Unapproached Leadership**," a reprint of steam plant tables in June, 1934, Power, showing 81% are users of Diamond **soot blowers.**

Forged Flanges—Kropp Forge Co., 5301 West Roosevelt Road, **Chicago, Ill. 4-page** folder on double-hub and high-hub boiler flanges of the forged type.

Specialties — Hills-McCanna Co., 2349-59 Nelson St., Chicago, Ill. Comprehensive catalog, "Hills-McCanna **Products,**" combines catalogs on this company's various products, including alloys, lubricators, valves, thermometer wells, pyrometer protection tubes, and grease pumps.

Steel and Boiler Tubes—A. B. Murray Co., Inc., 147-165 Wolcott St., Brooklyn, N. Y. 56-page warehouse stock list.

Centrifugal Pumps—Worthington Pump & Machinery Corp., Harrison, N. J. 6-page Bulletin W-310-B4A, superseding W-310-B4 on Types C, CA and CB centrifugal pumps.

Transmission Belting—The B. F. Goodrich Co., Akron, Ohio. 28-page catalog, including directions for making the recently described Plylock belt joint.

Chain Drives — Link-Belt Co., Indianapolis, Ind. 32-page Book 1425. Highly pictorial presentation of "Silverstreak" silent chain drive applications.

Insulating Testing Instruments — James G. Biddle Co., 1211-13 **Arch St., Philadelphia**, Pa. 32-page catalog 1400 on "Megger" testers.

Metal Insulating Material — American Flange & Mfg. Co., Inc., 26 Broadway, New York, N. Y. 8-page folder "Ferro-Therm—Something New in Insulation."

Cutting Machine—A. C. Campbell, Inc., Bridgeport, Conn. Folder describing Model 302 horizontal wet abrasive cutting machine, for cutting flat or slab materials and bar stock.

Testing Screens — **Hendrick Mfg. Co.,** Carbondale, Pa. Folder "Choose the Testing Screen Best Suited to Your Needs," describes complete line of portable and stationary testing screens.

Spray Equipment—Binks Mfg. Co., 3114 Carroll Ave., Chicago, Ill. 32-page Bulletin AD-114 "Spray Painting and Finishing Equipment," giving prices and descriptions.

Stokers—Link-Belt Co., 2410 W. 18 St., Chicago, Ill. Two folders, No. 1458-9, contain data on underfeed screw type stokers in sizes up to 3,000 sq.ft.

Circuit Breaker—General Electric Co. 8-page folder describing a new, moderate-capacity, oil-blast, circuit breaker. Type FK-43. Gives description and dimensions.

Turbine Oil Purification—S. F. Bowser & Co., Inc., Fort Wayne, Ind. 16-page, Book F on systems for maintaining turbine oil.

Water Cooling—Marley Co., Kansas City, Mo. 48-page Bulletin 54 completely illustrated, showing outstanding water-cooling installations during the last nine years.

Gears & Sprockets—Medart Co., 3500 De Kalb St., St. Louis, Mo. 80-page Catalog 56-G, containing standard listings, weights and dimensions on gears, sprockets and chain.

Water-Tube Boilers — Springfield Boiler Co., Springfield, Ill. 40-page Catalog 350 Illustrated descriptions of recent installations and "Suggested Rules for the Care and Operation of Power Boilers.

Coal Directory — Coal Information Bureau, Inc., Union Trust Bldg., Pittsburgh, Pa. Annual Coal Directory and Buyers Guide, $10 per copy. Complete trade information, listing mines, selling companies, coke plants, etc.

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Ariz., Chandler—Chandler Heights Irrigation Dist., Chandler, plans irrigation water and power facilities, incl. pipe lines, well, power plant and transmission lines. $94,000. P.W.A. loan approved.

Conn., Norwalk—Norwalk Hospital, plans by A. Schultz, 36 Euclid Ave., Maplewood Ave., brick boiler house and equipment. $28,500.

Ill., Hillsboro—Petitions circulated asking City Council to call election on $180,000 bond issue, for constructing electric light and power plant, gas plant and distribution system.

Ill., Wood River—City making plans power plant. Burns & McDonnell Eng. Co., 107 Linwood Blvd., Kansas City, Mo., engrs.

Ia., Fairfield—City Council preliminary studies constructing dam and municipal light and power plant operated by steam, distribution system submitted. $450,000-$1,000,000. Marsh Eng. Co., 206 Masonic Temple, Des Moines, engrs.

Ia., LaPorte City—Bids July 9, by City Council, constructing and equipping electrical power and distributing plant, incl. 2 diesel engines with generators. $100,000. Young & Stanley, Inc., Muscatine, engrs.

Kentucky — Kentucky Utilities Co., R. M. Watt, Pres., announces the following improvements. Installation of switching, cooling and substation equipment and the extension of a 33,000 volt transmission line at Lexington $38,700. Building 33,000 volt transmission line from New Haven to Hodgenville. $36,000. Enlarging power substations at Maysville, Carrollton, Richmond, Lebanon, Boonesboro, Buena Vista, Burgin, Versailles and Mt. Sterling, $35,000. Rebuilding 21 miles of 33,000 volt transmission line between Bowling Green and Franklin and 12 miles of line between Woodburn and Auburn. $32,000.

Ky., Middlesboro—City Officials will go ahead with plans for issuance of $328,000 in bonds for municipal power plant, on which there was an injunction passed several months ago.

Me., Portland—City, J. E. Barlow, mgr., City Hall, sketches by E. L. Higgins, 514 Congress St., 1 story, brick, steel boiler house, concrete found. at Farrington Hospital, Brighton Ave. $40,000.

Mich., Saline—Village retained Francis Eng. Co., engrs., Eddy Bldg., Saginaw, to prepare plans and estimates for complete brick, steel, concrete municipal light and power plant. To exceed $105,000.

Miss., Greenwood—City making plans power plant improvements. $200,000. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, Mo., engrs.

Minn., Hutchinson—Municipality plans electric light and power plant. $250,000. Buell & Winter, Sioux City, engrs.

Minn., Mimmeota—Village, R. Gitts, clk., soon takes bids installing turbine pump and one 20 hp. diesel engine for water plant.

Minn., Preston—Village, no action taken on bids June 11, constructing 39x72 ft. power plant, incl. equipment. $40,000, incl. equipment. Injunction obtained against letting contract.

Minn., Spring Valley—Municipality plans electric light and power plant. To exceed $50,000. G. M. Orr, Baker Bldg., Minneapolis, archt.

Minn., Thief River Falls—City voted $60,000 for additional power plant equipment. P. G. Pederson, city clk.

Missouri—Empire District Electric Co., c/o Cities Service, 60 Wall St., has been refused extension for time for constructing hydro-electric project on White River at Table Rock near Galena by Federal Power Commission and proceedings have been started to cancel license. $30,000,000.

Mo., Annapolis—Estate of L. H. Kallemaier, 8647 North Bway, plans hydro-electric dam and power plant on Black River. $16,000. P.W.A. loan applied for. Russell & Axon, 4903 Delmar Blvd., St. Louis, engrs.

Neb., Beatrice—Southeast Nebraska Public Power Dist. plans rural electrification improvement. $600,000. Burns & McDonnell Eng. Co., 107 West Linwood Blvd., Kansas City, engrs. P.W.A. project.

N. J., Trenton—Dpt. Institutions & Agencies, plans by H. A. Kelley, State House, remodeling hospital and construction new power plant. $407,500. P.W.A. project.

N. Y., Horseheads—Village making plans electric plant to be operated by diesel engines. $105,000. H. E. Childs, Sayre, Pa., engr.

N. Y., Lake Placid—Village plans completed repairing generating plant. $30,000. C. W. Judson, Lake Placid, engr.

N. Y., Lockport—City plans municipal power plant and tunnels, Hawley St. L. A. Harding, Prudential Bldg., Buffalo, engr.

N. C., Sanford—Town, H. Kennedy, clk., E. W. Fields, Alderman, plan application with P.W.A. for funds to finance construction municipally-owner power plant and transmission lines. $304,000.

O., Cleveland—Fairview Park Hospital, c/o H. Schmitt, pres., 3305 Franklin Blvd., plans by George S. Rider Co., archts. and engrs., Marshall Bldg., power plant, laundry and dispensary hospital additions.

Okla., East Duke — Town plans municipal light plant. $30,000. Engineer not appointed. Applied for P.W.A. funds.

Oregon—Bids July 10, by U. S. Eng., 2nd Portland Dist., 627 Pittock Blk., Portland, furnishing, installing lock operating equipment at Bonneville, incl. upper and lower miter gates with complete operating machinery, 4 taintor valves with complete operating machinery, 6 floating mooring bitts, complete and floor plates and grating.

Pa., Warren—Comrs. Warren Co., Warren and Freehold Twp. Supervisors, plan flood protection and control dam and hydro-electric system in Freehold Twp. $200,000. **Maturity indefite.** P.W.A. project.

Tex., Alice—City, R. Graham, mayor, preliminary planning and surveying for power plant, some improvements to present waterworks system. Plans election soon to repay government loan in event it is obtained. $100,000. P.W.A. project.

Tex., Mason—City, c/o A. E. Grosse, secy., preliminary surveys, etc., municipal electric light plant. $70,000. Engineer, c/o owner, engr.

Tex., Sanatorium—State Bd. Control sketches ice making and electric power plant, incl. building, machinery for 15 ton ice capacity, generating unit, etc. $36,000.

Wyo., Casper — Bids July 22, by Bureau Reclamation, E. Mead, comr., Casper, constructing Seminoe Dam and power plant, Casper-Alcova Project, incl. 541,500 cu.yd. all classes opencut excav.; 22,000 cu.yd. tunnel excav. Spec. 630.

Alta., Edmonton—City Council voted $1,064,000 for extension to city power plant, incl. supply and installation of 20,000 KWH. generator and 1 boiler building and all necessary equipment.

Alta., Fort McMurray—Brooks Electrical & Radio Engineers Ltd., 9548 Jasper Ave., Edmonton, preparing plans constructing new power house, also transmission and distribution lines.

B. C., Trail—West Kootenay Power & Light Co. preparing plans constructing substation, 12,000 hp. capacity, at Stoney Creek.

N. S., North Sydney—R. P. Bell plans cold storage plant, $50,000. Architect to be appointed soon.

N. S., Truro—Truro Electric Light Comn. preparing plans constructing central heating plant.

Ont., East Windsor — Ford Motor Co. of Canada, East Windsor, W. R. Campbell, pres., has taken bids for power house, equipment will be added to present plant. $2,000,000.

Que., Donracona—Municipality making plans for electrical development. P. Chalifour, secy., interested in prices of equipment.

Sask., Kelliher—William Humphries preparing plans constructing flour mill and power plant.

Sask., Saskatoon—Lemeny-Denison Electric Co., Ltd., plans repairing electric plant. Est. about $75,000. Engineer not appointed.

India, Calcutta — Calcutta Electric Supply Corp., preparing plans constructing power station on new 43 acre site at Mulagar, $1,000,000.

South Africa—Griqatown City Engineer interested in prices for supplying and erecting of electrical plant, oil engine, generators, motors, cutouts, overhead line equipment, etc.